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MISSOURI RIVER WATER QUALITY SURVEY 1955-1956. CHARTS AND PRELIMINARY NOTES

Public Health Service
Kansas City, Missouri

1956

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MISSOURI RIVER WATER QUALITY SURVEY

1955 - 1956

CHARTS AND PRELIMINARY NOTES

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PRELIMINARY NOTES
MISSOURI RIVER WATER QUALITY STUDIES
COLIFORM DATA

The accompanying figures depicting various considerations of coliform-type bacteria concentration in the Missouri River are based upon data furnished through the cooperation of water treatment plant operators at Omaha, Nebraska; Council Bluffs, Iowa; St. Joseph, Missouri; Kansas City, Kansas; Lexington, Missouri; and Boonville, Missouri. Operators at Omaha, Council Bluffs, and Kansas City, Kansas, made available their routine daily analysis results. Personnel at the Missouri plants began daily analyses in February 1955 at the special request of the Missouri Division of Health and Public Health Service. Collection of data at the six localities is continuing. This report concerns the period February 1955 to December 1956, inclusive.

Collection and assembly of data were initiated in order to secure a current picture of coliform densities and relationships in the heavily polluted river, lacking such information since 1950.

Water plant records are not illustrative of maximum and minimum coliform levels occurring in the lower Missouri River. However, these sites represent areas of most critical water use, where the coliform concentration is of vital concern.

Spatial Relationships

Average MPN value was, approximately, 20,000 at Omaha; 10,000 at Council Bluffs; 80,000 at St. Joseph; 30,000 at Kansas City, Kansas; 90,000 at Lexington; and 50,000 at Boonville. This pattern reflects location with respect to great pollutional discharges, and at least in

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one instance, location with regard to current patterns in the river. The Omaha intake, situated to draw from the main path of flow, has a coliform concentration that mainly represents the residue of quantities introduced with raw wastes at Sioux City, Iowa, a large meat packing center. The Council Bluffs water intake does not extend into the main current, and water withdrawn there is not as representative of upstream conditions as that secured at Omaha. Similar differences are evident in certain chemical constituents at the two localities.

Coliform organisms at St. Joseph are largely those left from concentrations contributed by raw domestic sewage and meat packing wastes entering the river from the Omaha area. The distance from Omaha to St. Joseph (about 160 river miles) is almost 50 miles greater than the length of river between Sioux City and Omaha. Greater concentration at St. Joseph may be occasioned by a larger waste load (that from Omaha) or a reduced die-away rate. Kansas City, Kansas, about 75 miles below St. Joseph, exhibited a somewhat lower coliform density. That intake is affected by wastes discharged at St. Joseph, Atchison, and Leavenworth. Lexington, Missouri, about 55 miles below major waste discharges from the Kansas City area, had the highest average coliform density occurring at the six localities. Boonville, about 183 miles below Kansas City, showed a marked decline below the Lexington figure.

From these data it would appear that greater quantities of discharged wastes maintain higher coliform concentrations and extend them over greater stream distances. Sampling at water intakes does not always include most representative sections of river discharge, and this factor may mask the actual differences in coliform concentration at various localities.

However, it is evident that coliform-type bacteria increase with contributed pollution.

Seasonal Relationships

Average monthly concentrations at the six localities (Figures 1-6) serve to basically illustrate seasonal variation. Months with highest average MPN values differed from year to year. In 1955 Omaha experienced the highest concentration in July; in 1956 the maximum occurred in November. At Council Bluffs annual high figures were in September and July, respectively, for 1955 and 1956. At St. Joseph, annual high months were June and September; at Kansas City, Kansas, October and July; at Lexington, June and June; and at Boonville, November 1955, June, and November 1956.

Monthly frequencies of various numerical classes (5,000; 10,000; and 20,000) at each station (Figures 7-12)[1] show marked individual variation. Percentage of samples exceeding certain densities varied considerably on a monthly basis at each station, and stations did not always agree upon which months were most critical. Percentages exceeding criteria for the three classes were high. In almost all instances densities greater than 20,000 occurred more than 5 percent of the time. Higher levels increased their frequency at and below St. Joseph.

On a seasonal basis (Figures 13-18)[2], density was highest in the summer season both years at Omaha, Council Bluffs, St. Joseph, Lexington, and Boonville. At Kansas City, Kansas, highest average concentration

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[1]Legends in these figures indicate percentage of samples above 5,000; 10,000; 20,000 MPN (coliform) per 100 ml.

[2]Legends W., I., S. on these figures, indicate winter, intermediate, and summer seasons, respectively.

occurred during the intermediate season in 1955 and during the summer in 1956.

At Omaha, coliform organisms exhibited greatest survival rate in the intermediate (combined spring and fall) and summer seasons (Figures 13-24). The intermediate periods had densities in excess of 20,000 more frequently than summer seasons. Winter densities were markedly lower. At Council Bluffs, summer and intermediate seasons showed greater MPN values than winter, but summers exhibited higher densities more frequently than intermediate seasons. At St. Joseph, little difference was evident in frequency of various numerical classes in summer and intermediate periods; winter MPN values were greatly reduced. Seasonal differences were not as marked at Kansas City, Kansas, where the 20,000 class appeared about 70 percent of the time in winter, 77 percent of the time during intermediate periods, and slightly more than 80 percent of the time in summer. Lexington, Missouri, also showed less reduction in winter, and somewhat greater frequency of higher numerical classes in summer than in spring and fall. A more marked winter reduction occurred at Boonville, and summers and intermediate periods showed but slight differences in frequency of various classes.

Seasonal variation at different stations (Figures 25-30) shows no clear-cut trends in extent of seasonal fluctuation at each station.

In general, it would appear that open water seasons were most conducive to coliform survival (Figures 31-36). Temperature differences between spring and summer, summer and fall, seem to have had little influence. Discharge is rather uniform from early spring until late fall as a result of controlled navigation releases from mid-March to mid-November.

Variation as occurred was apparently insufficient to be a marked influence. Lower winter flows may have been instrumental in reducing the distance covered by the so-called "die-away curve."

Comparison of various years of record (Figures 37-39) indicates that three stations, Council Bluffs, Lexington, and Boonville, experienced higher summer densities before reservoir operation produced a controlled stream (1950), and that the other three attained greater summer concentrations after regulation was effected. At other seasons there appeared to be little difference in pre-and post-regulation levels.

At all stations except Kansas City, Kansas, and Lexington, Missouri, winter levels were noticeably less critical than those occurring during other seasons. At those two stations, dangers inherent in high coliform levels do not diminish with any seasonal influence.

Comparison of arithmetic averages and calculated true mean densities[3] (Figures 40-45) indicates that in most instances averages ranged above the true mean figures. The paths followed by each across the seasons were generally quite similar. In general, the 90 percent confidence range[4] extends across the average figure at each locality.

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[3]True mean density - A statistical analysis of coliform MPN data which endeavors to compensate for non-uniformity of bacterial distribution in natural waters. Here, true mean density is used as a statistical check on the validity of arithmetic average values.

[4]90% confidence factor - Range in which true mean density would lie in 90% of duplicate series of samples.

MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

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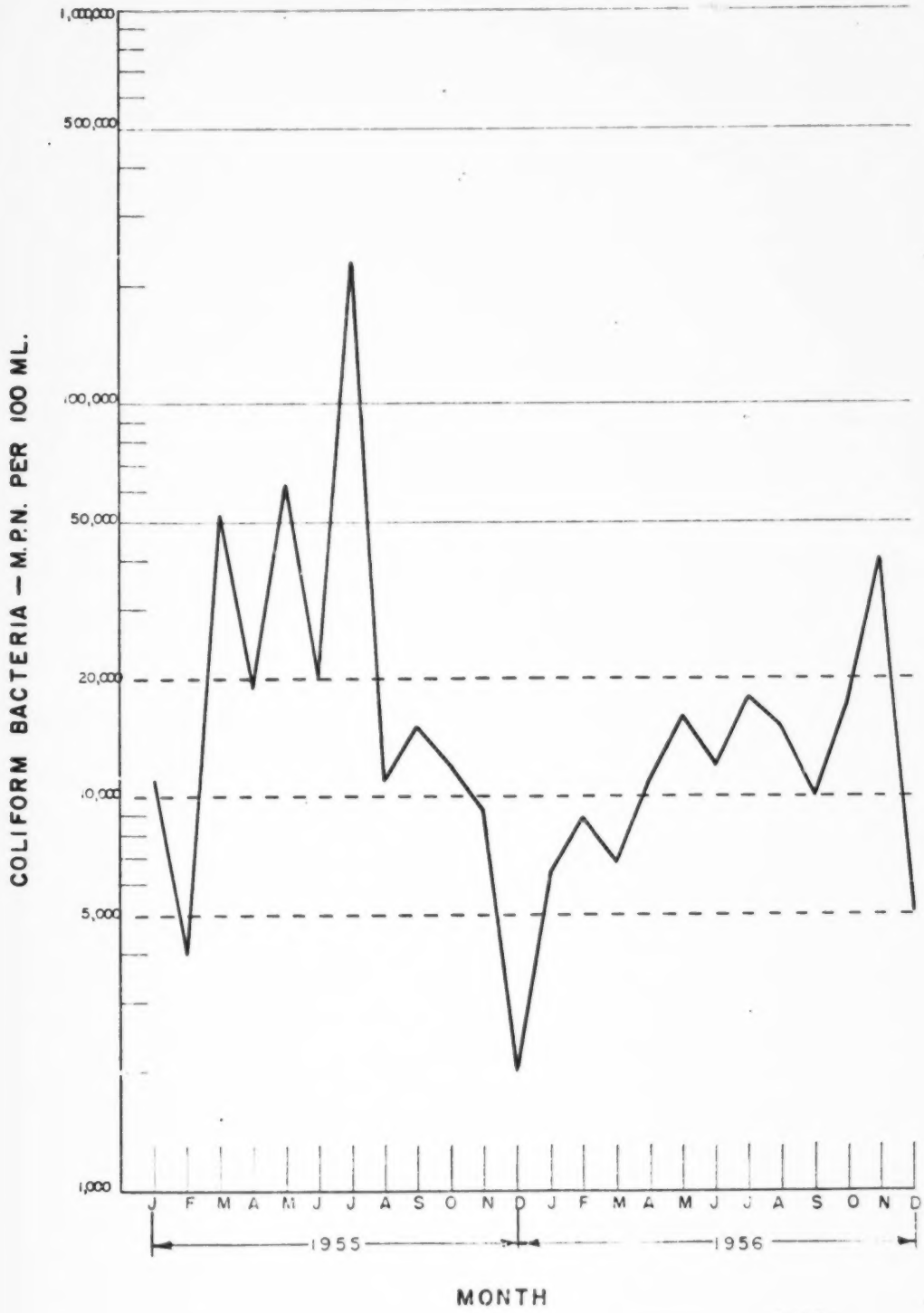
Region VII

OMAHA, NEBRASKA
RAW WATER INTAKE (1955-56)

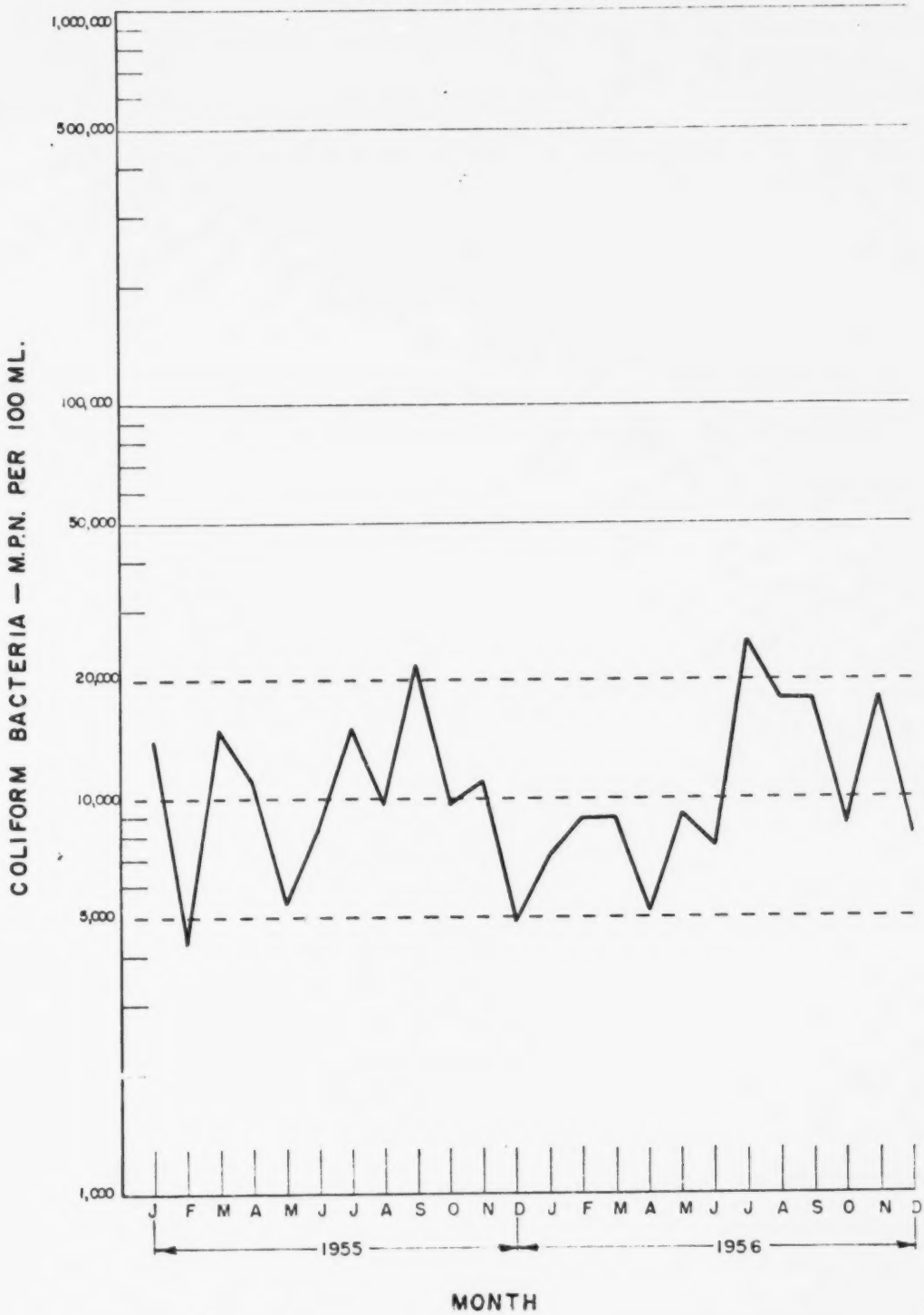


MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

COUNCIL BLUFFS, IOWA

RAW WATER INTAKE (1955-56)

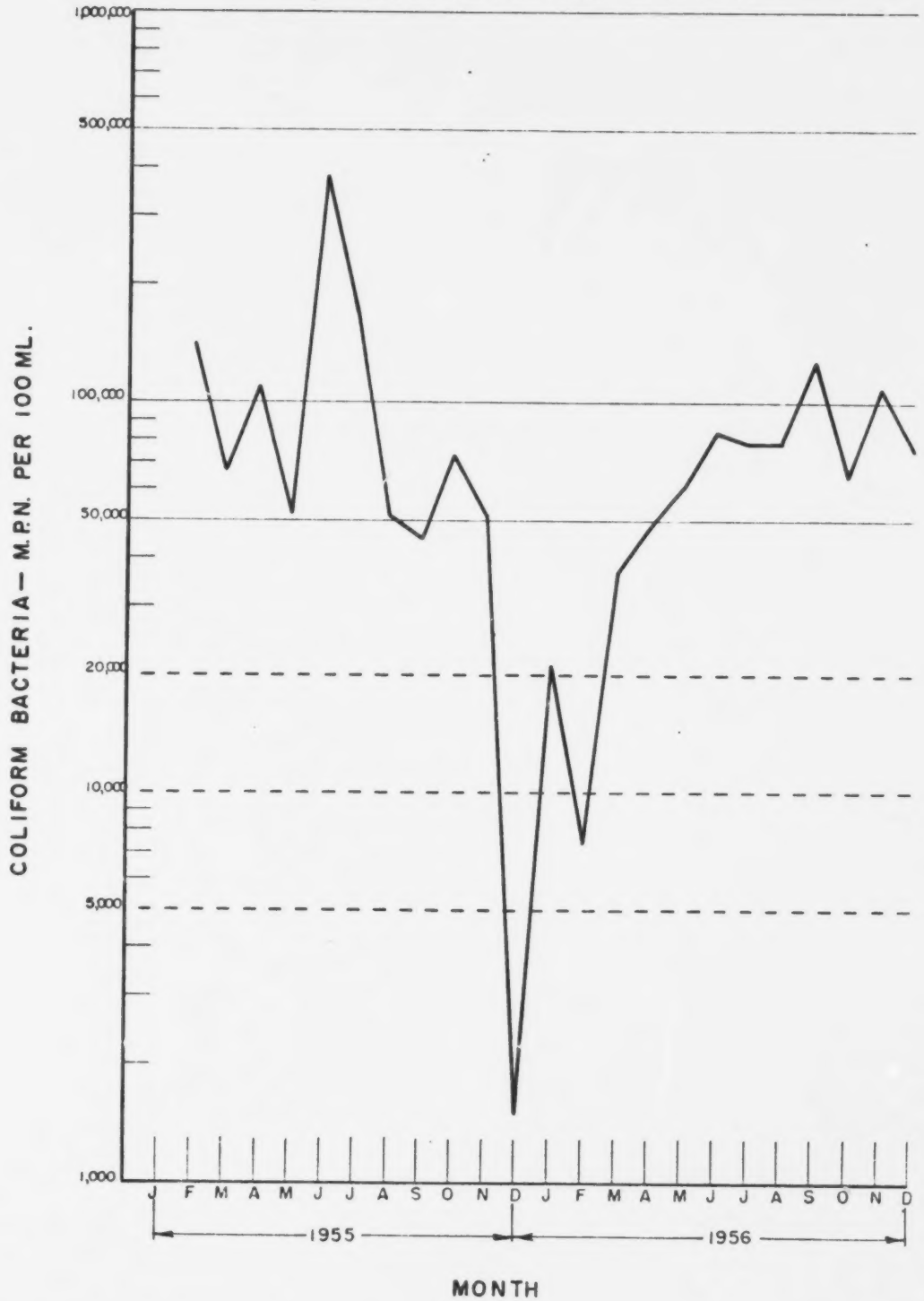


MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

ST. JOSEPH MISSOURI

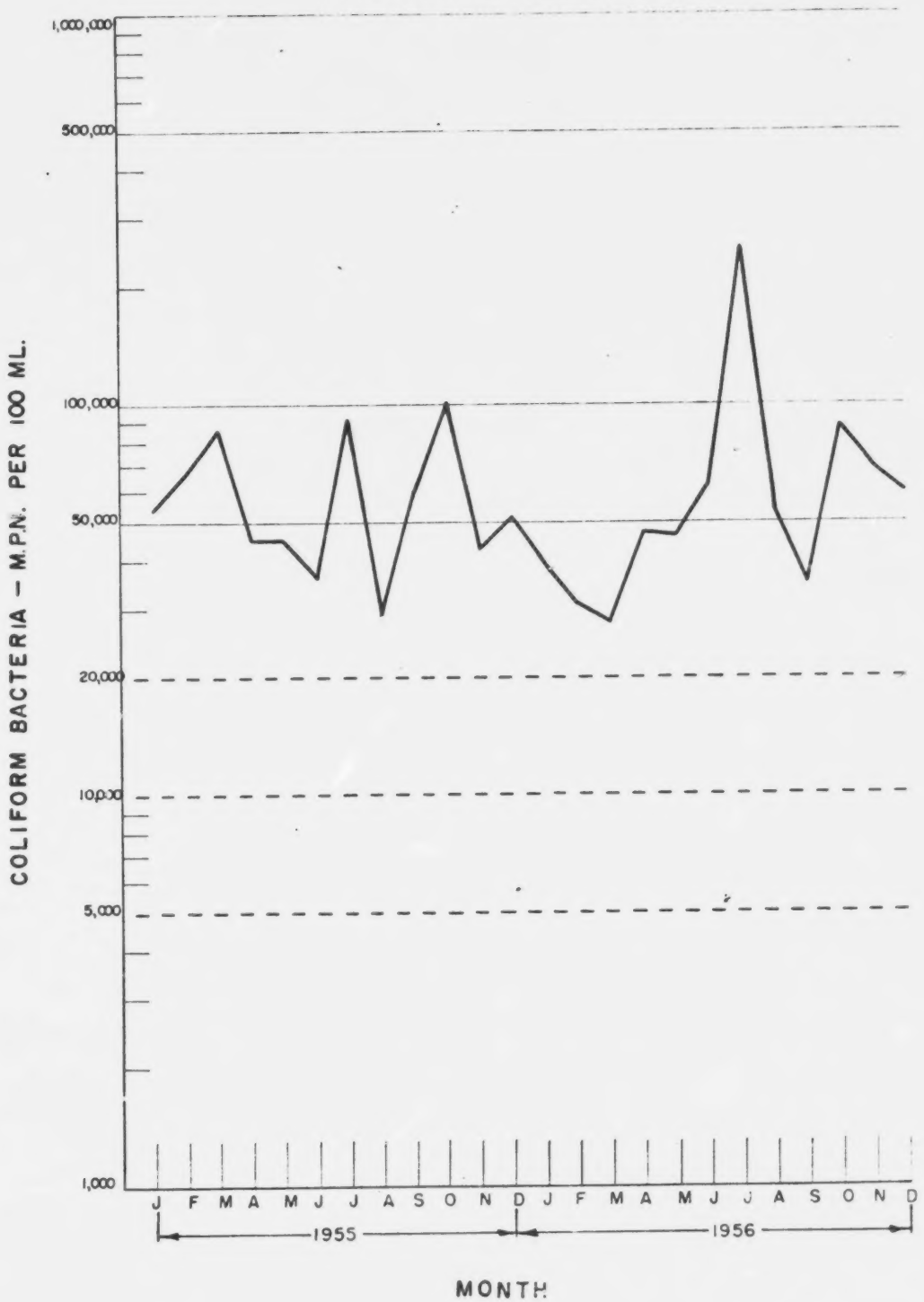
RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

KANSAS CITY, KANSAS
RAW WATER INTAKE (1955-56)

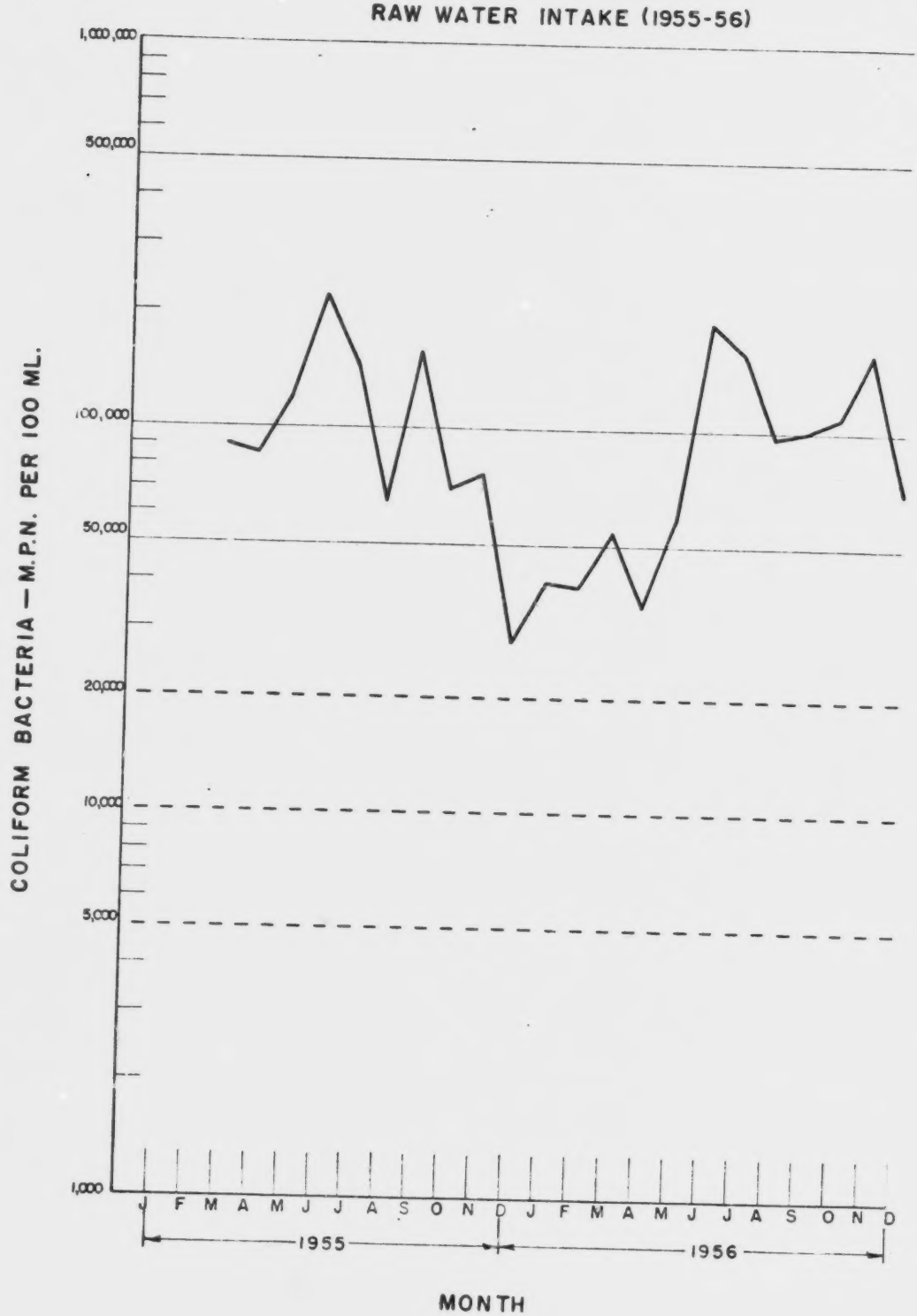


MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

LEXINGTON, MISSOURI

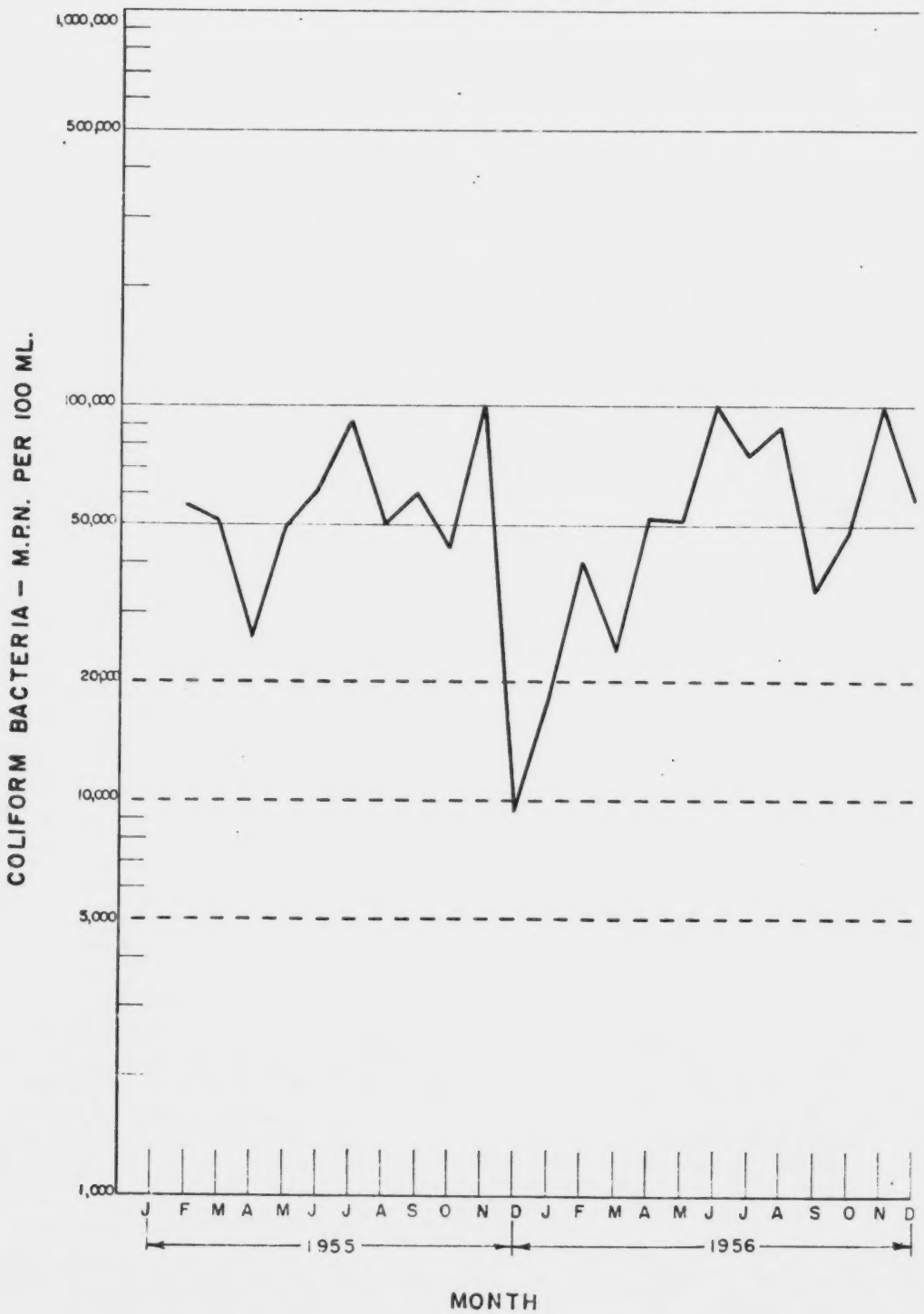
RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE MONTHLY COLIFORM DENSITIES

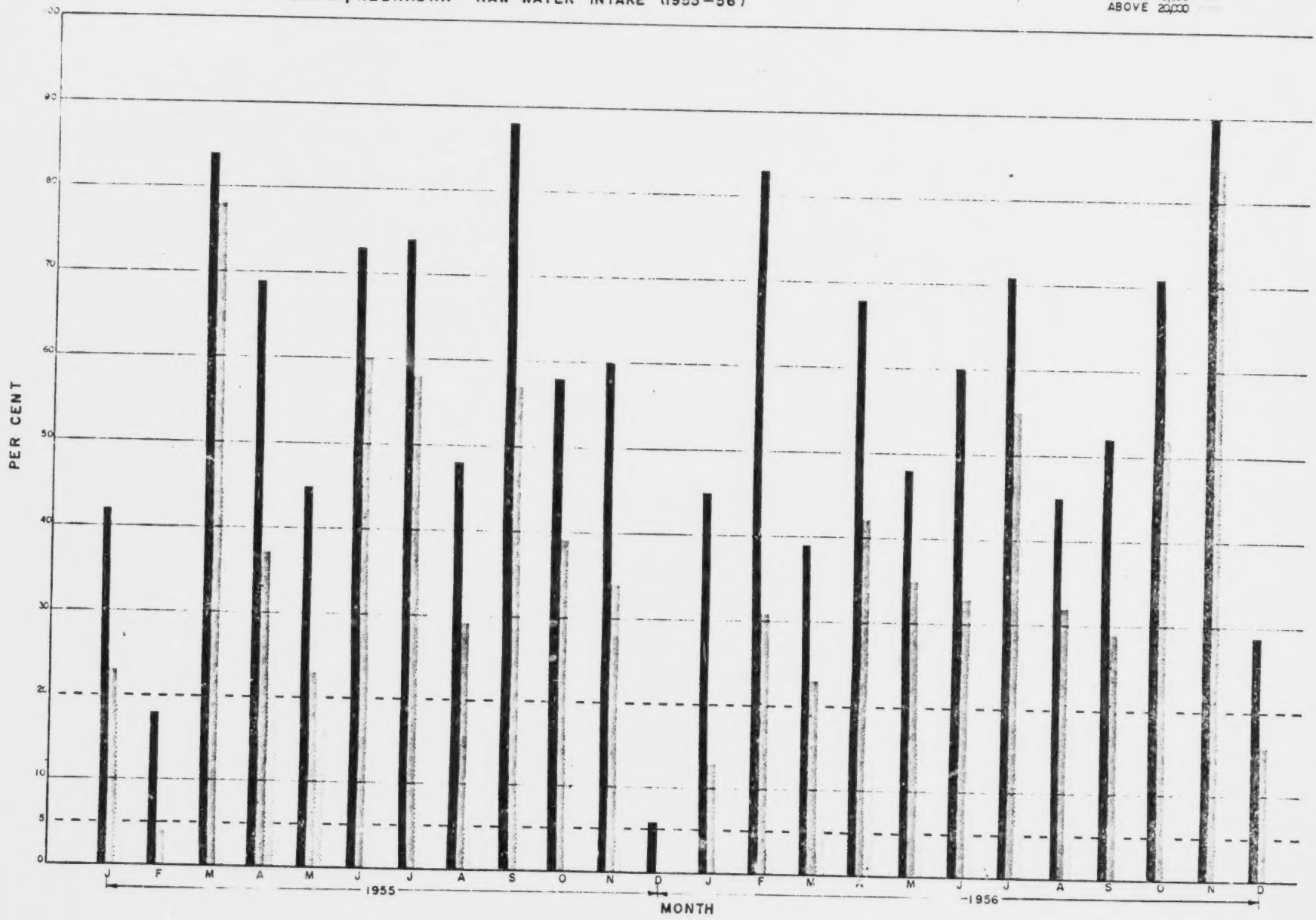
BOONVILLE, MISSOURI
RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARICUS LIMITS

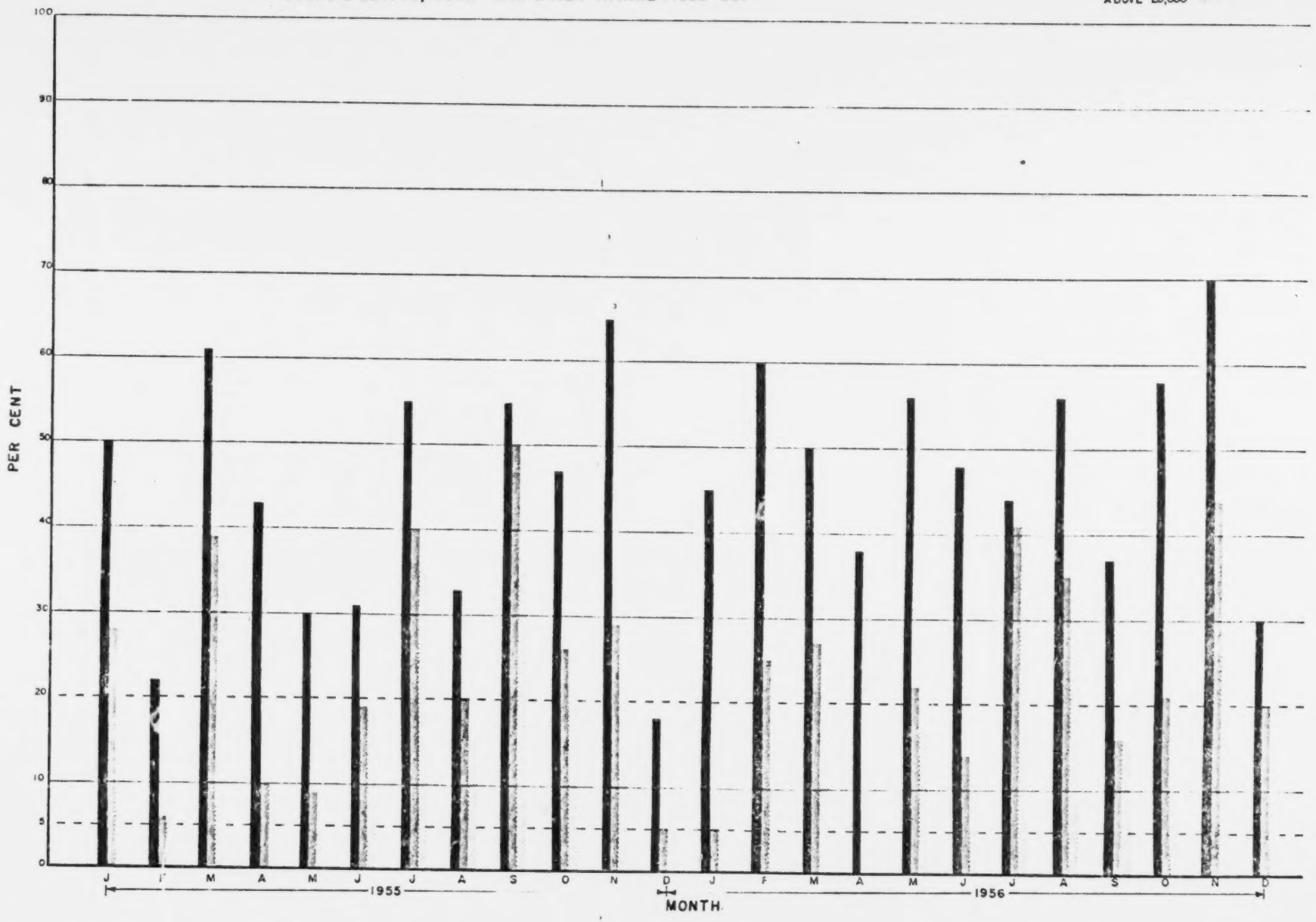
OMAHA, NEBRASKA RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARIOUS LIMITS

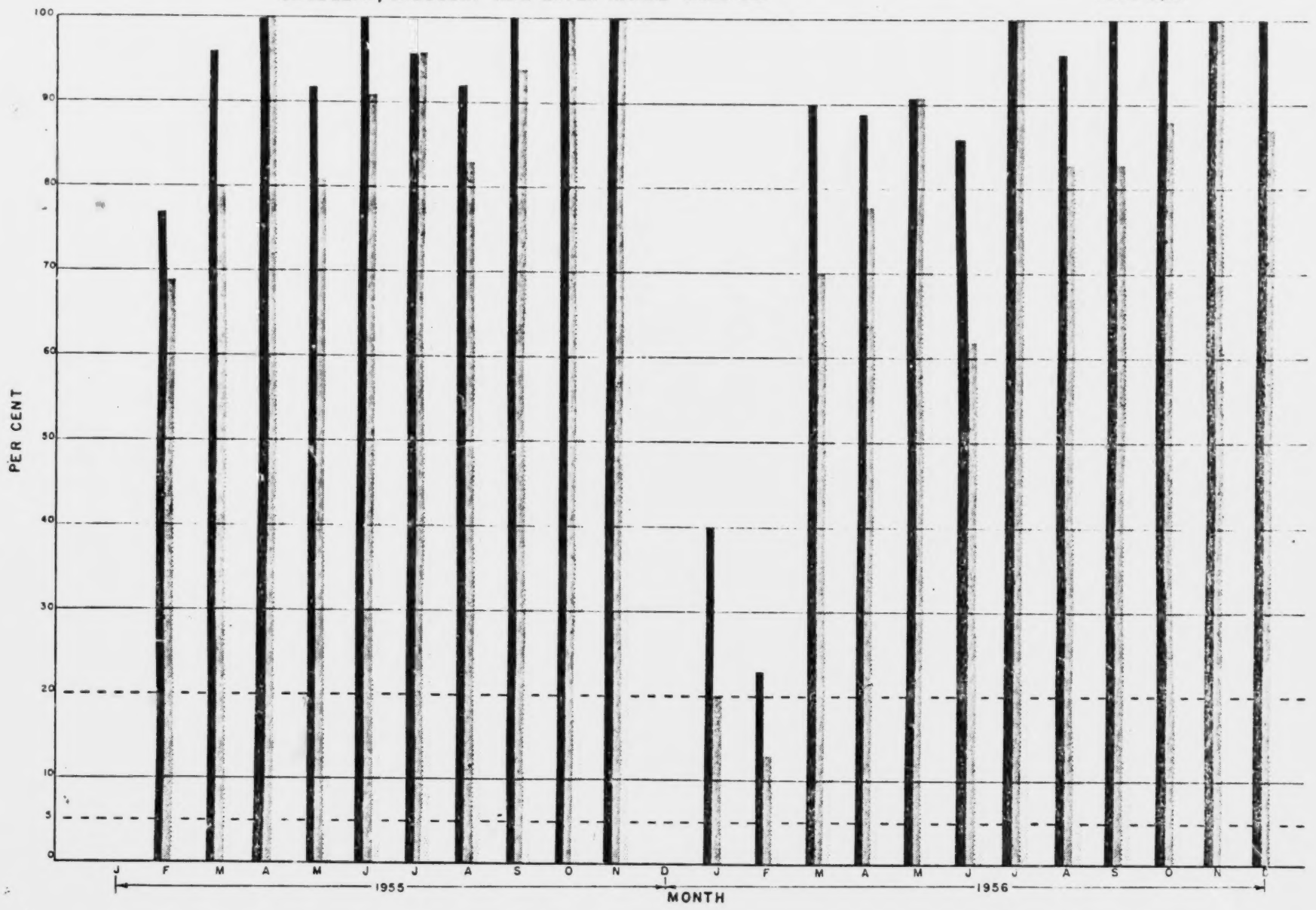
COUNCIL BLUFFS, IOWA RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARIOUS LIMITS

ST. JOSEPH, MISSOURI RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARIOUS LIMITS

KANSAS CITY, KANSAS RAW WATER INTAKE (1955-56)

MISSOURI RIVER WATER QUALITY SURVEY

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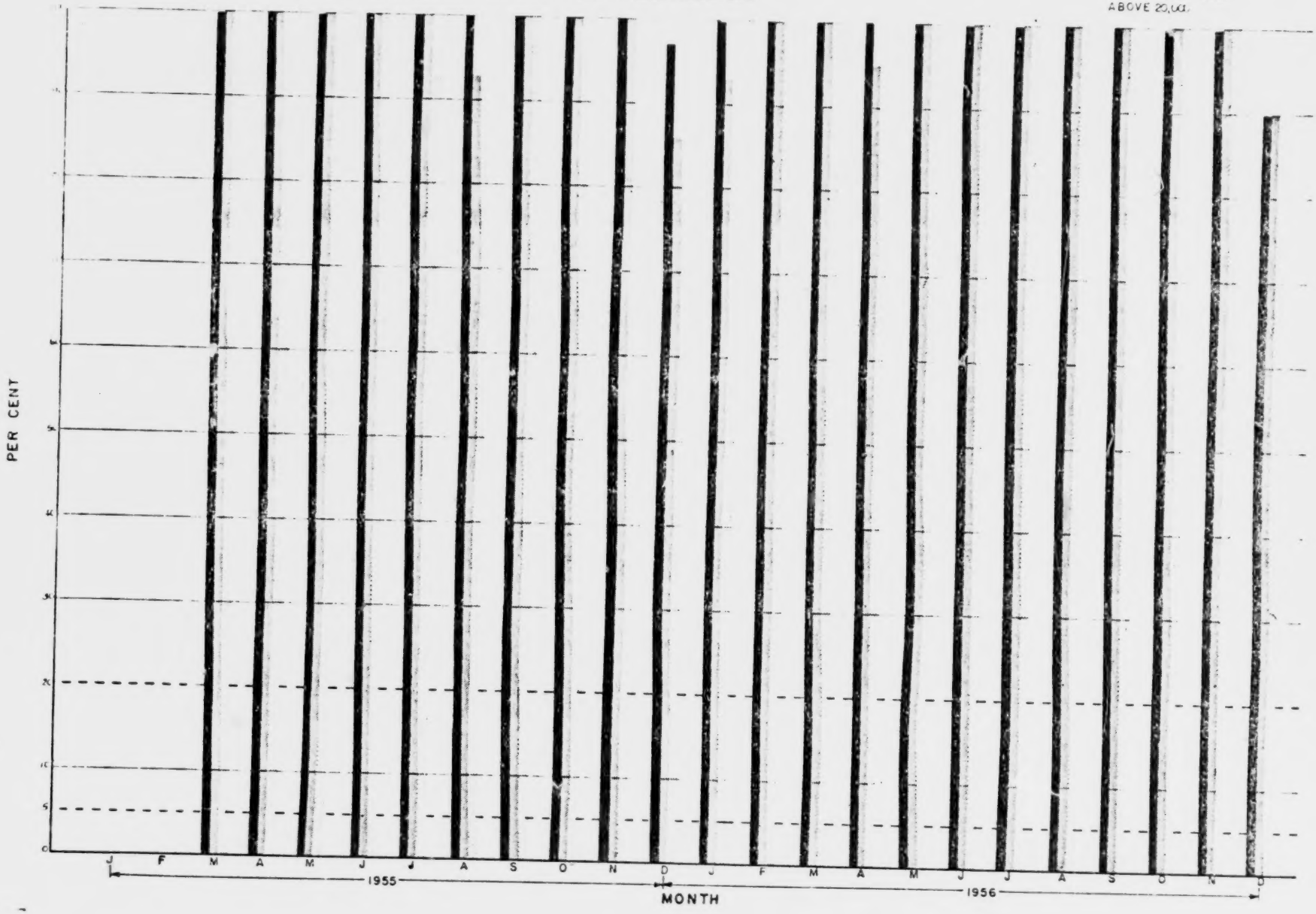
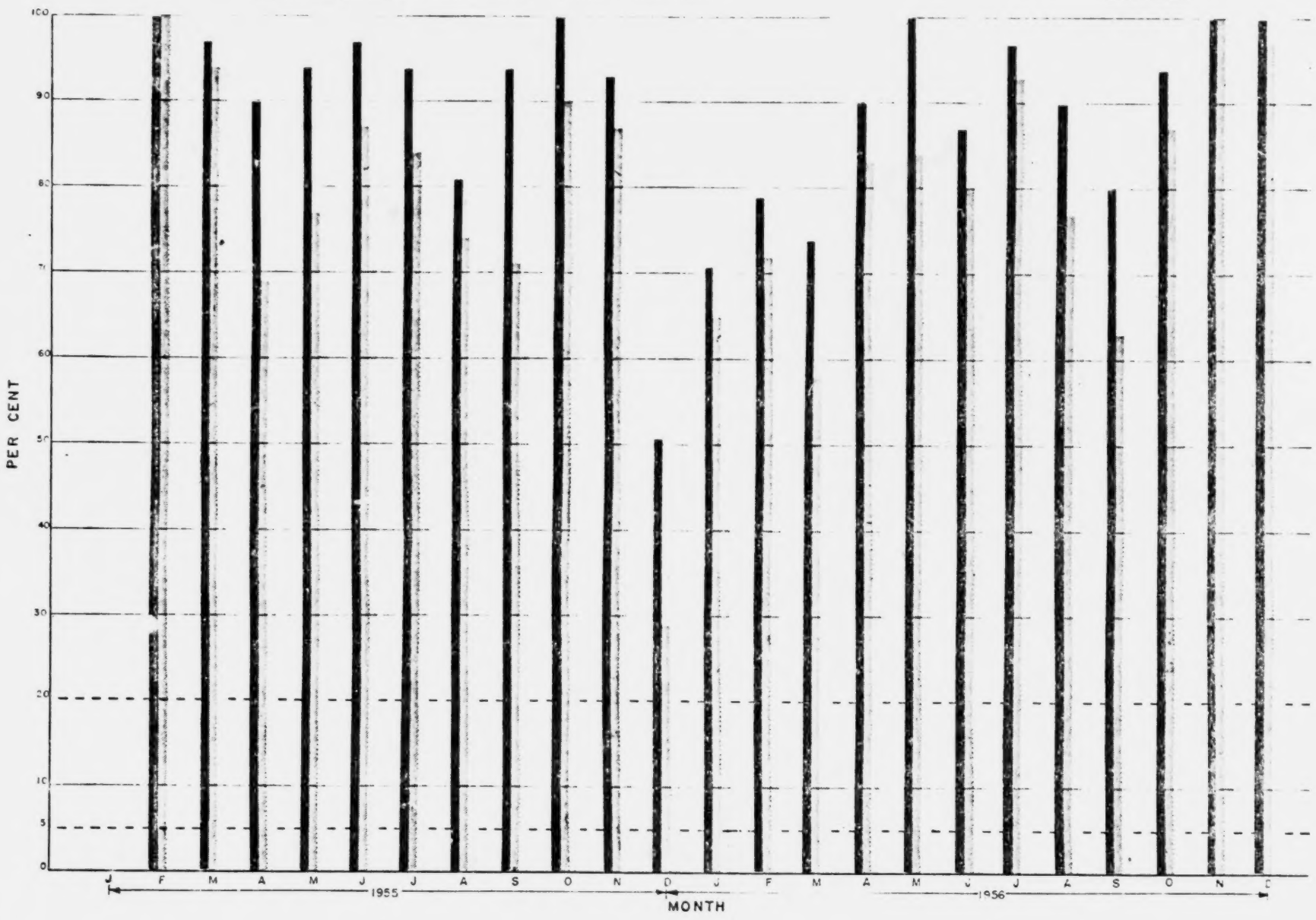
LEXINGTON, MISSOURI RAW WATER INTAKE (1955-56)



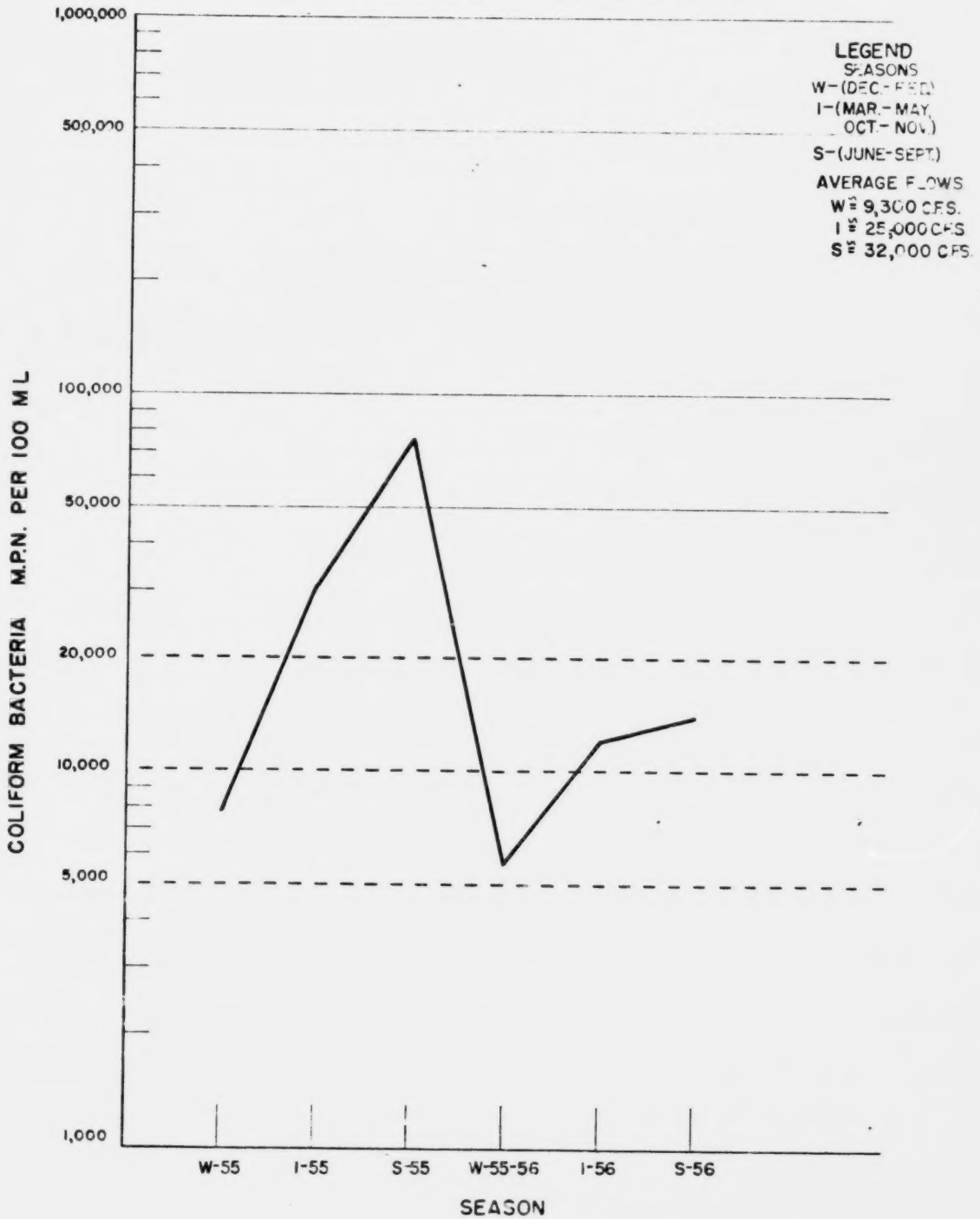
MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARIOUS LIMITS
BOONVILLE, MISSOURI RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE SEASONAL COLIFORM DENSITY
OMAHA, NEBRASKA
RAW WATER INTAKE (1955-56)



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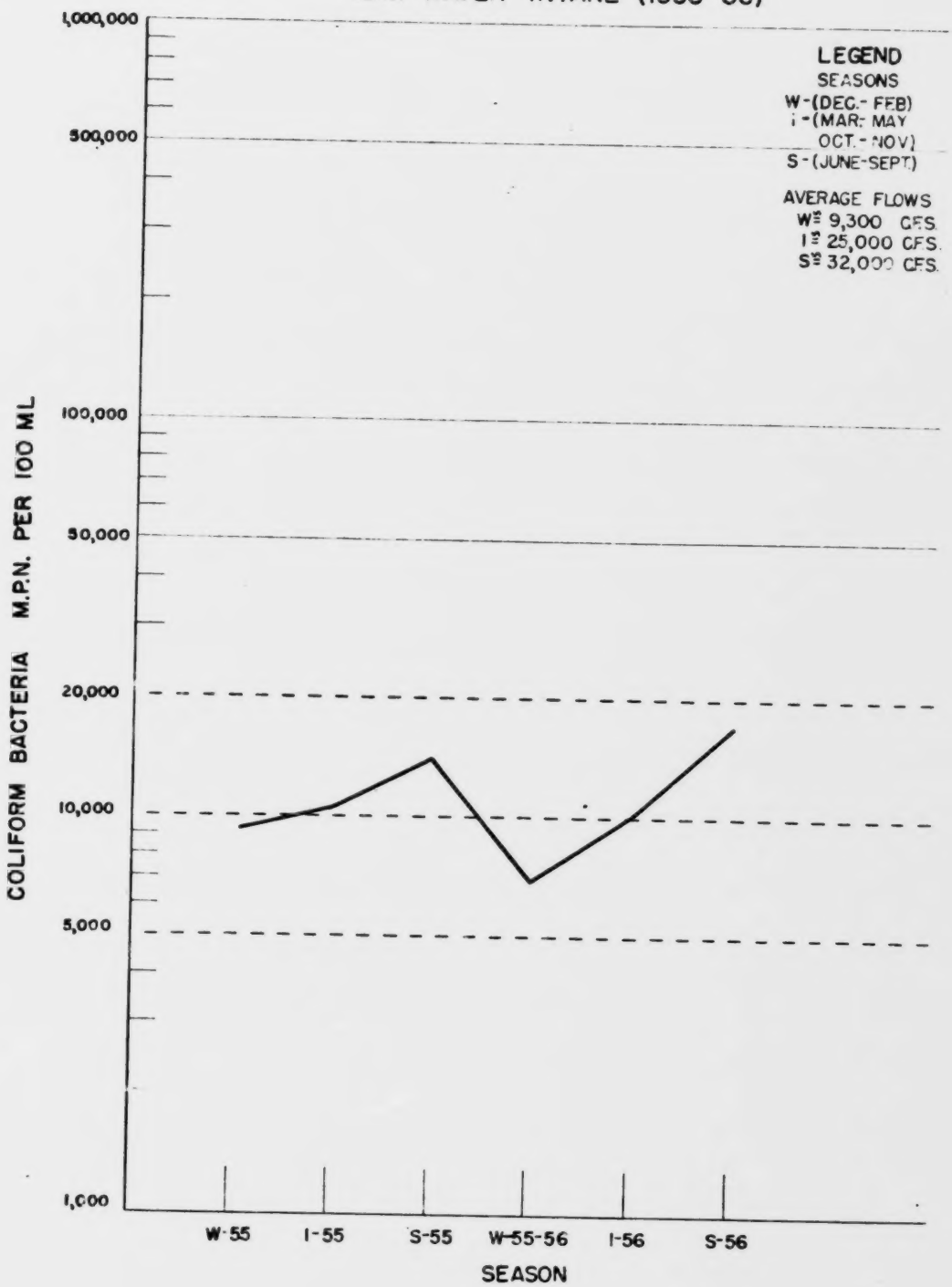
COUNCIL BLUFFS, IOWA
RAW WATER INTAKE (1955-56)



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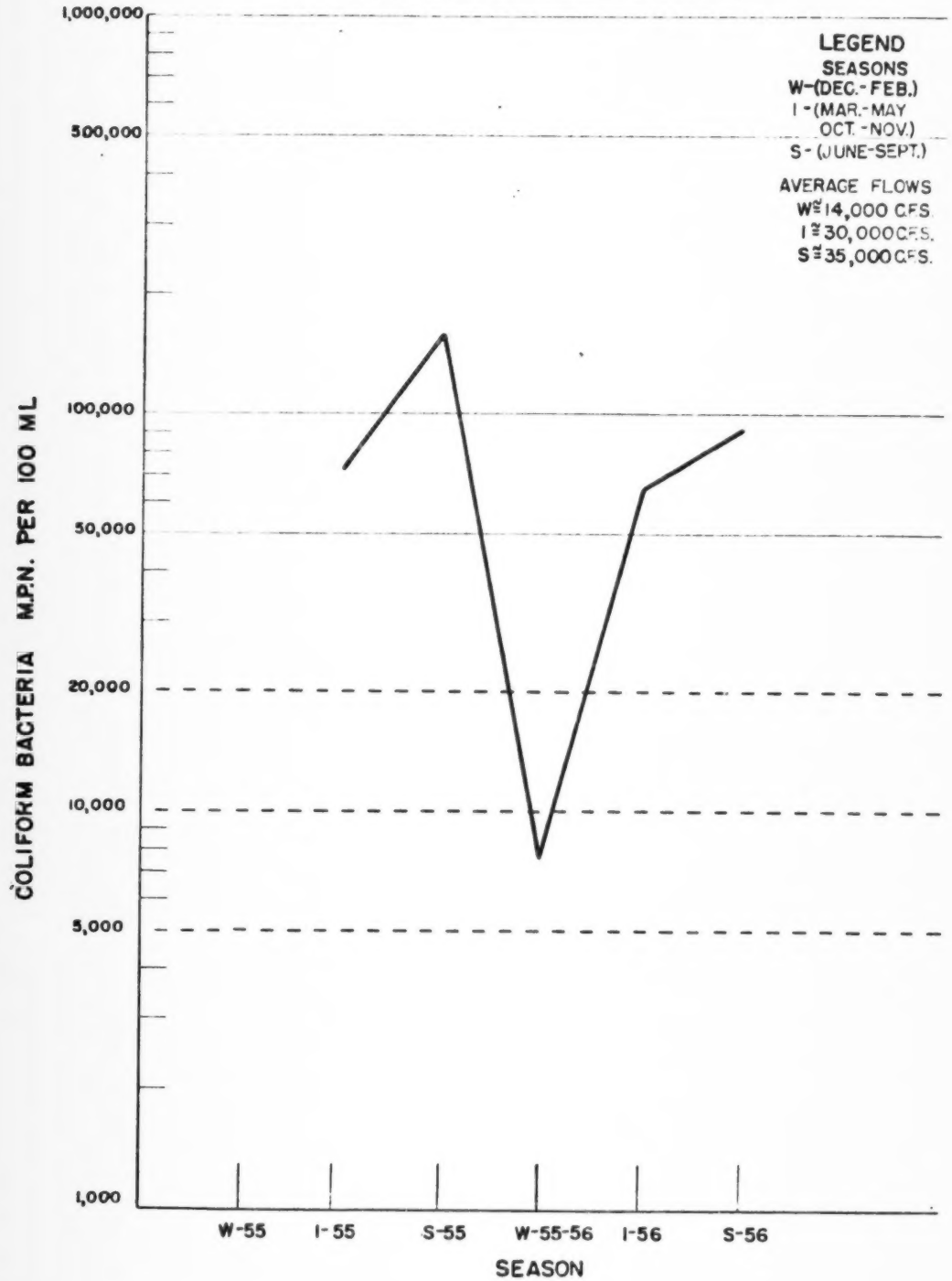
AVERAGE SEASONAL COLIFORM DENSITY
ST. JOSEPH, MISSOURI
RAW WATER INTAKE (1955-56)



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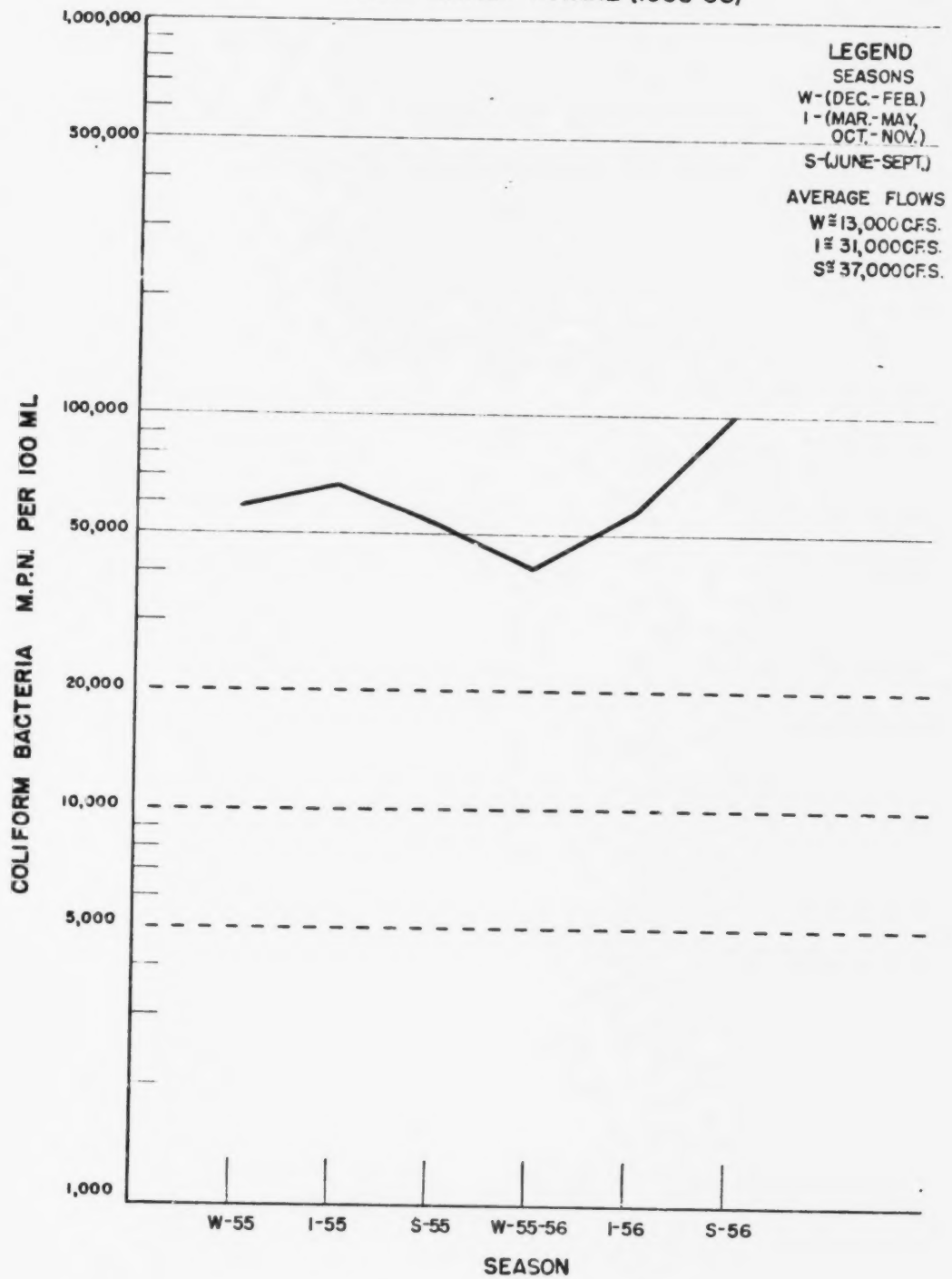

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LEXINGTON, MISSOURI
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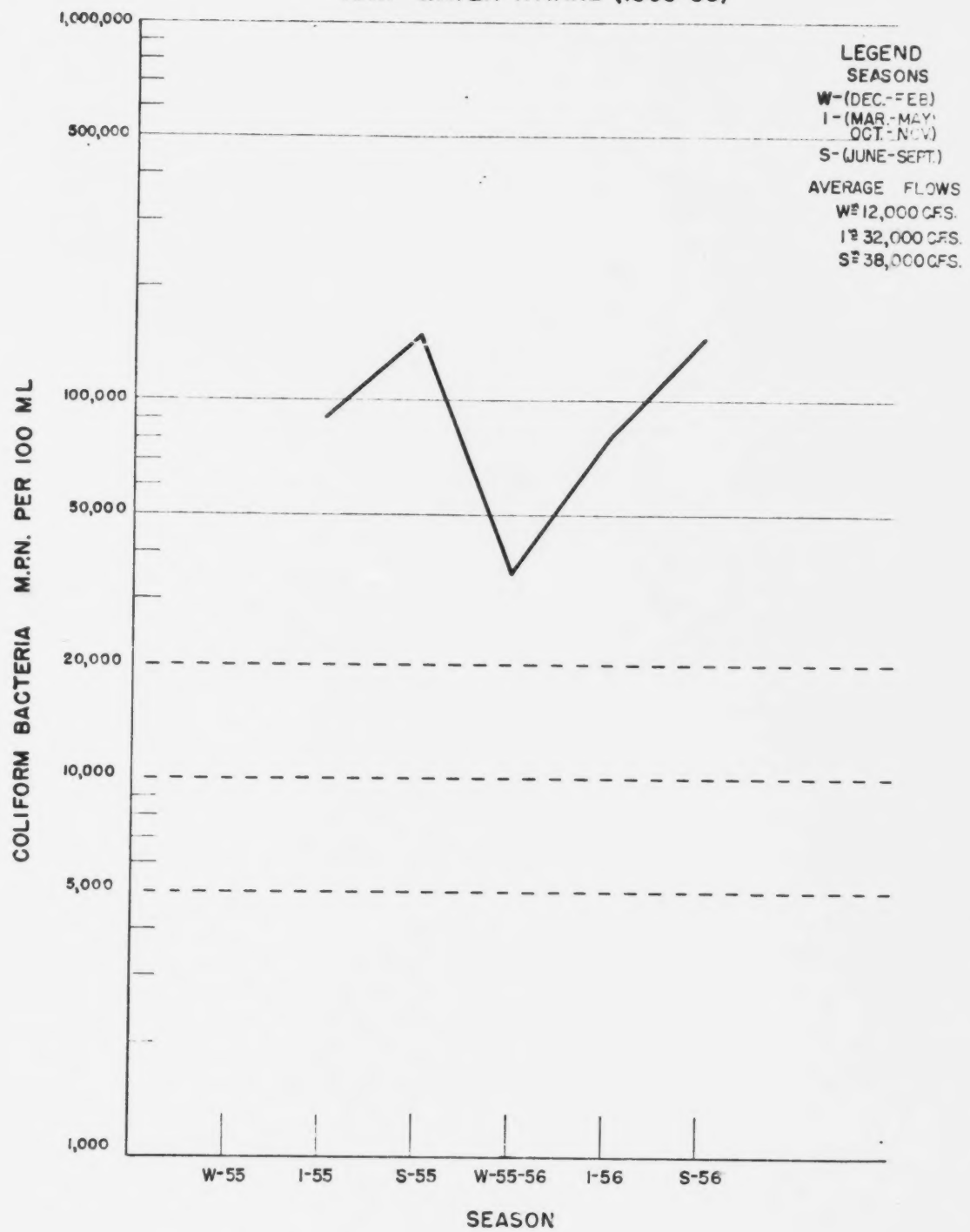

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BOONVILLE, MISSOURI
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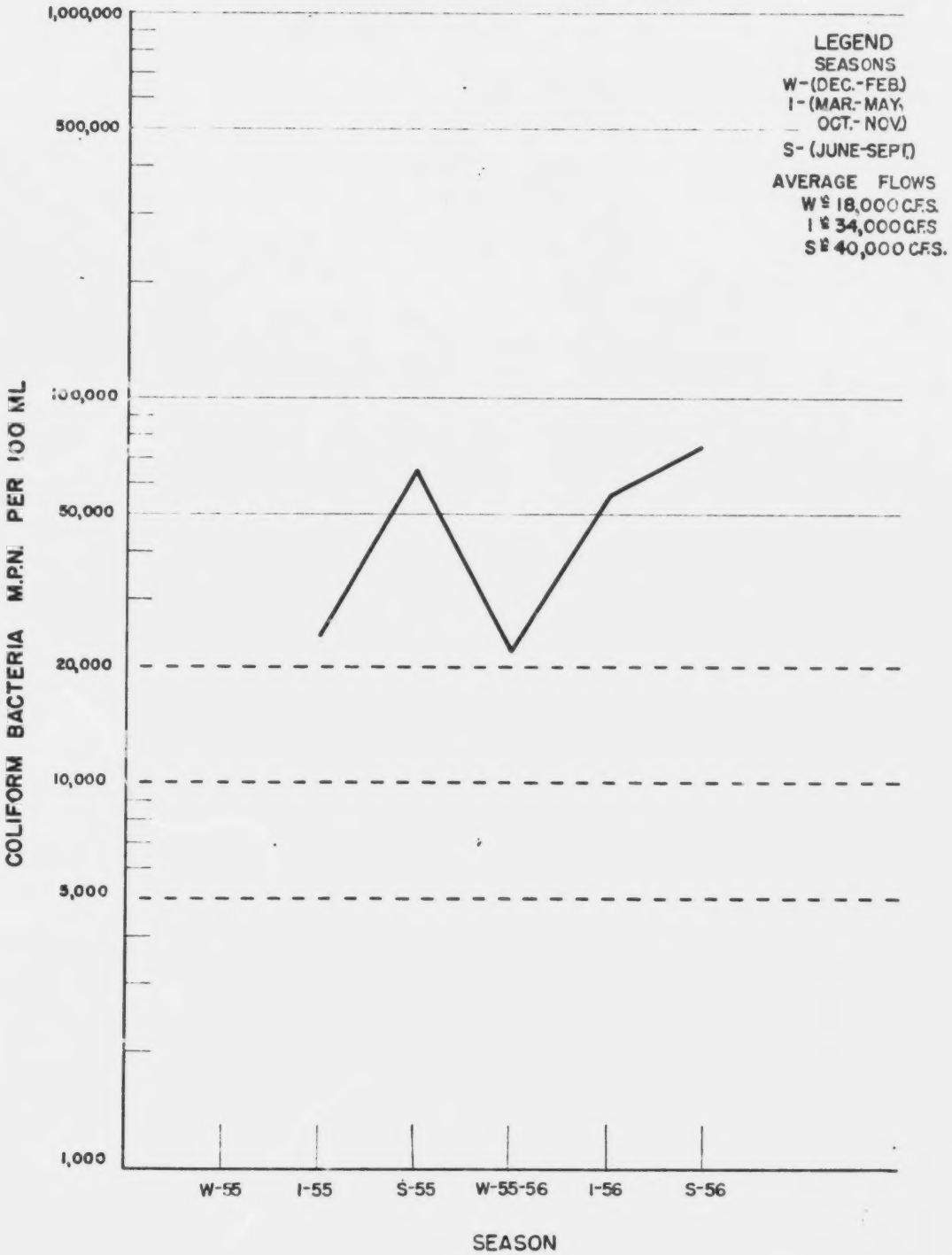
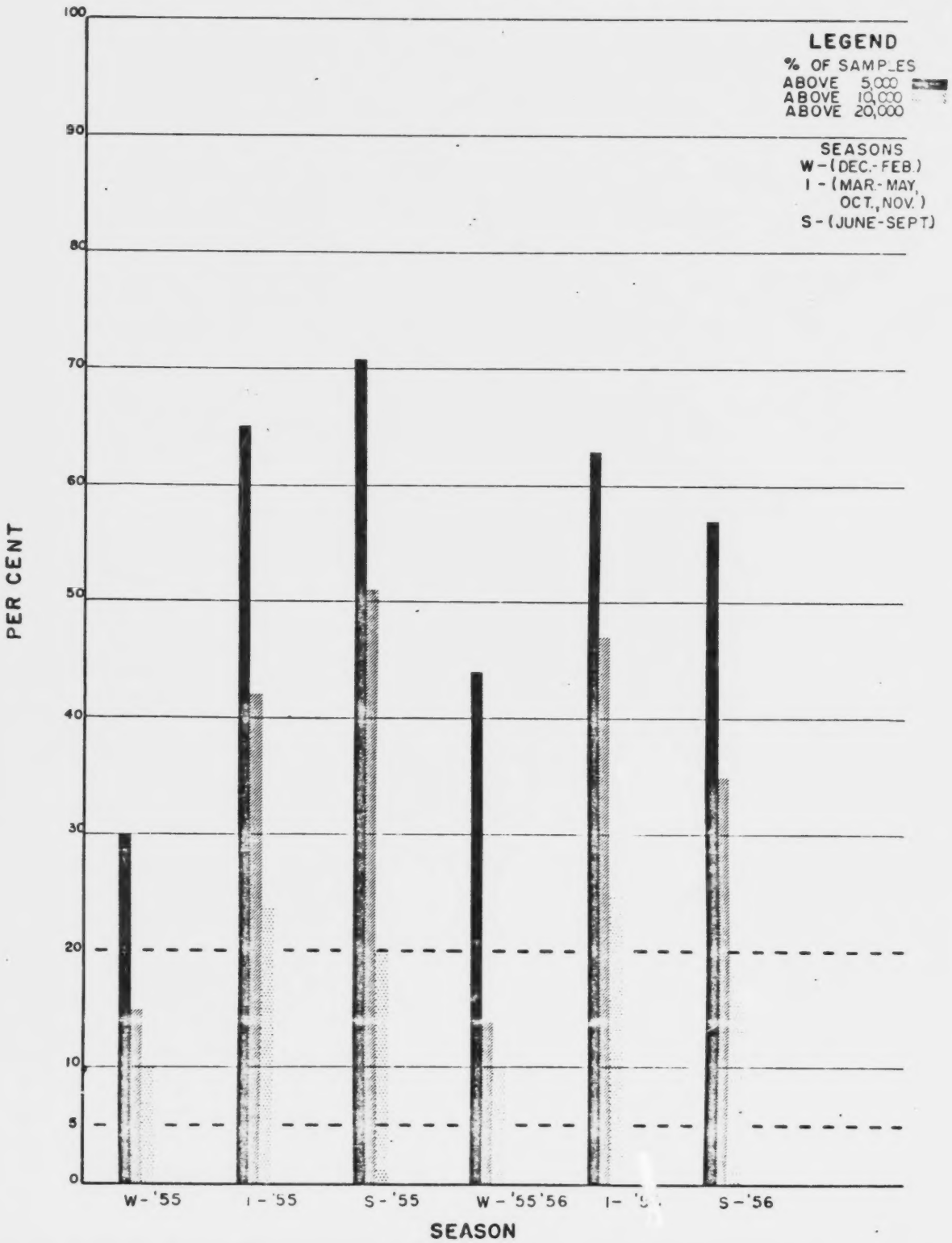


MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

OMAHA, NEBRASKA
RAW WATER INTAKE (1955-56)



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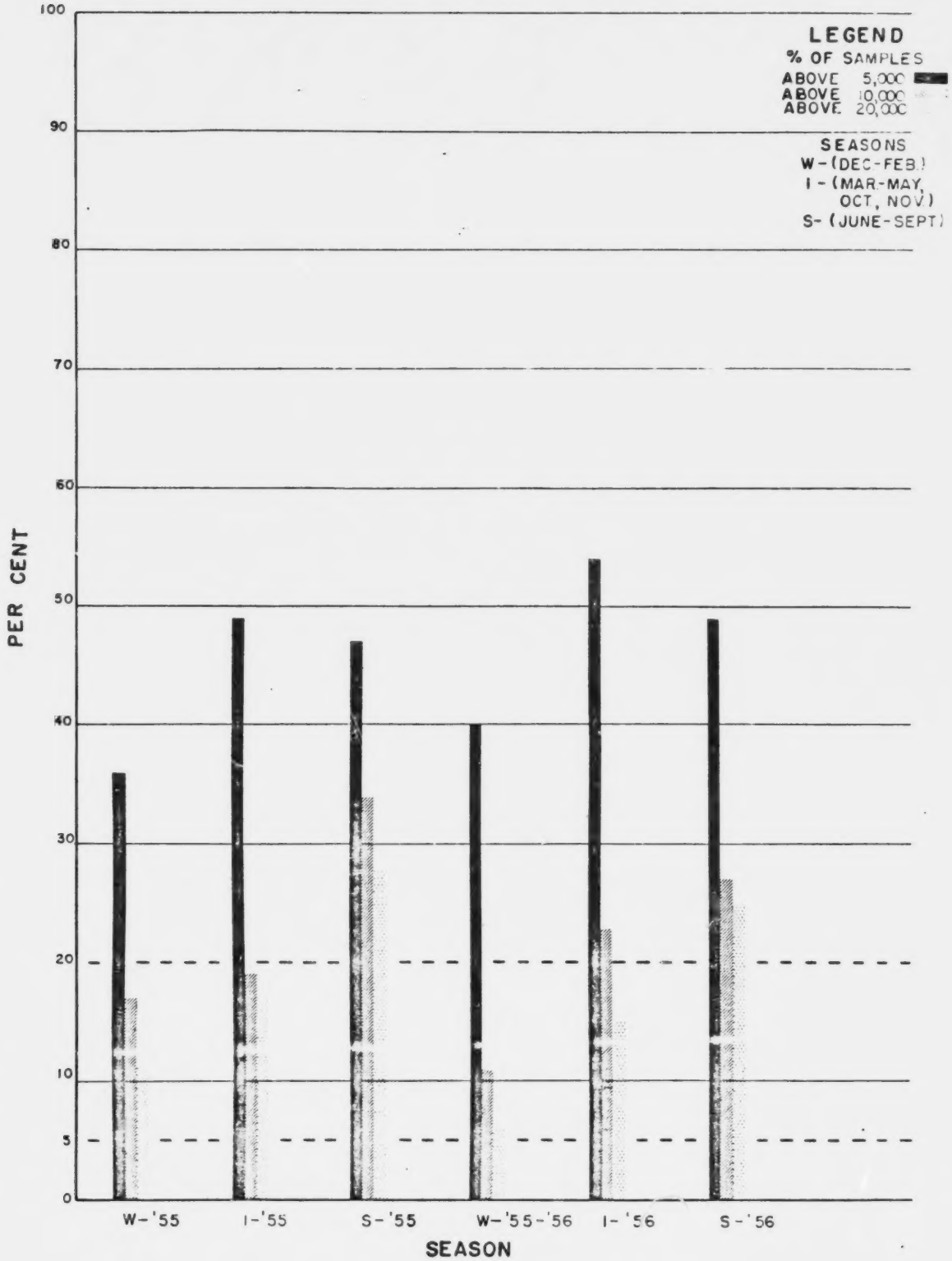

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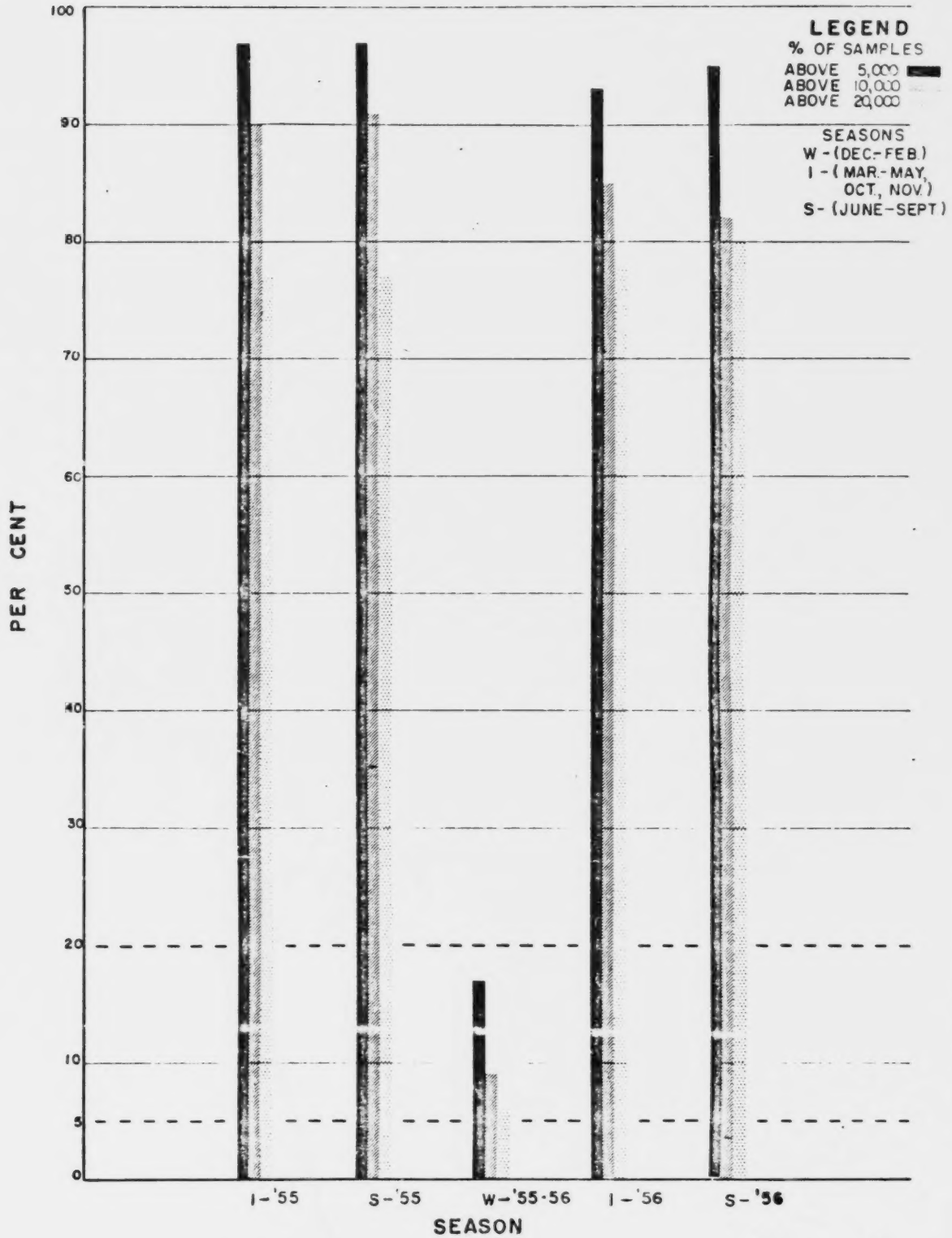

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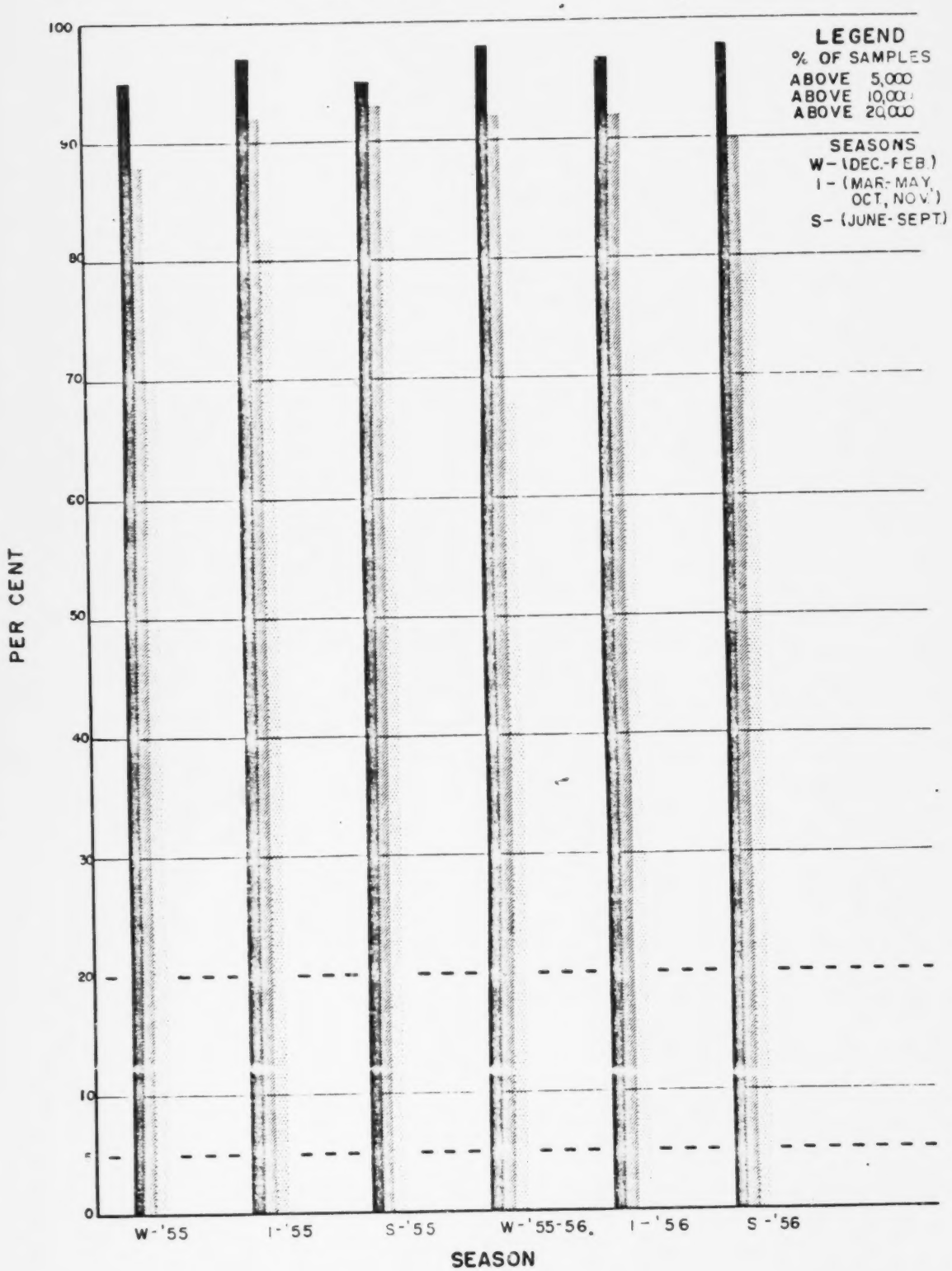

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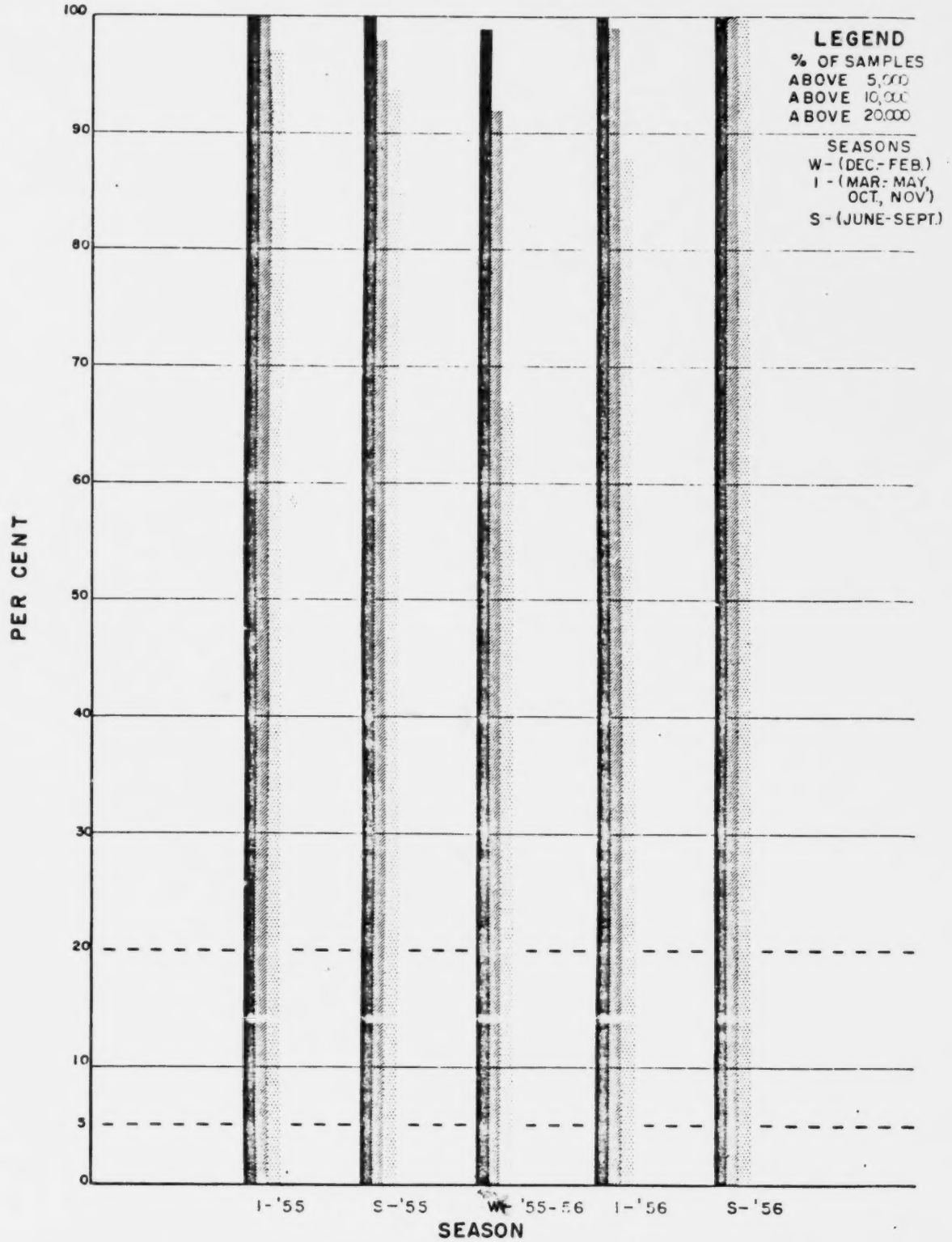
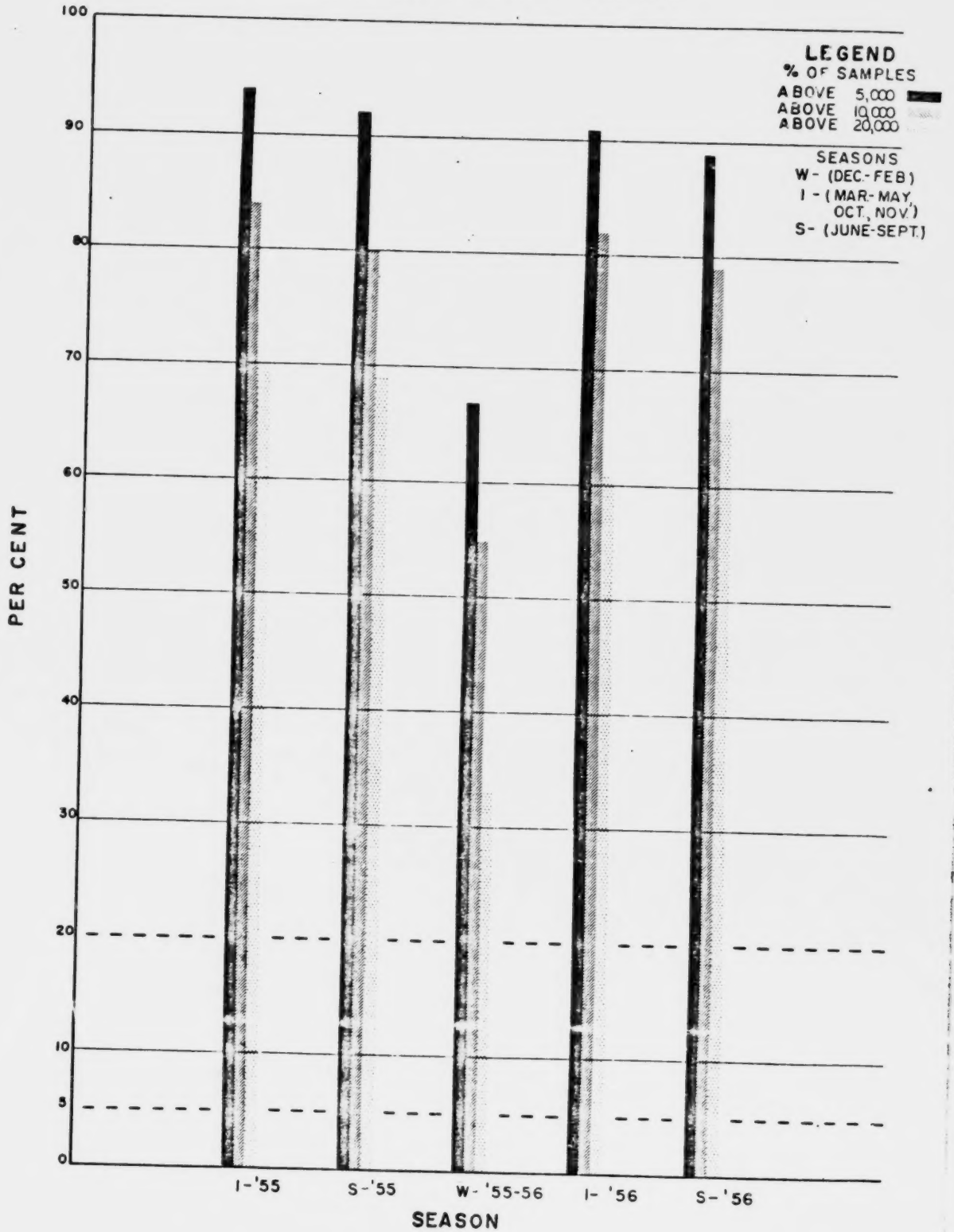


MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

BOONVILLE, MISSOURI
RAW WATER INTAKE (1955-56)

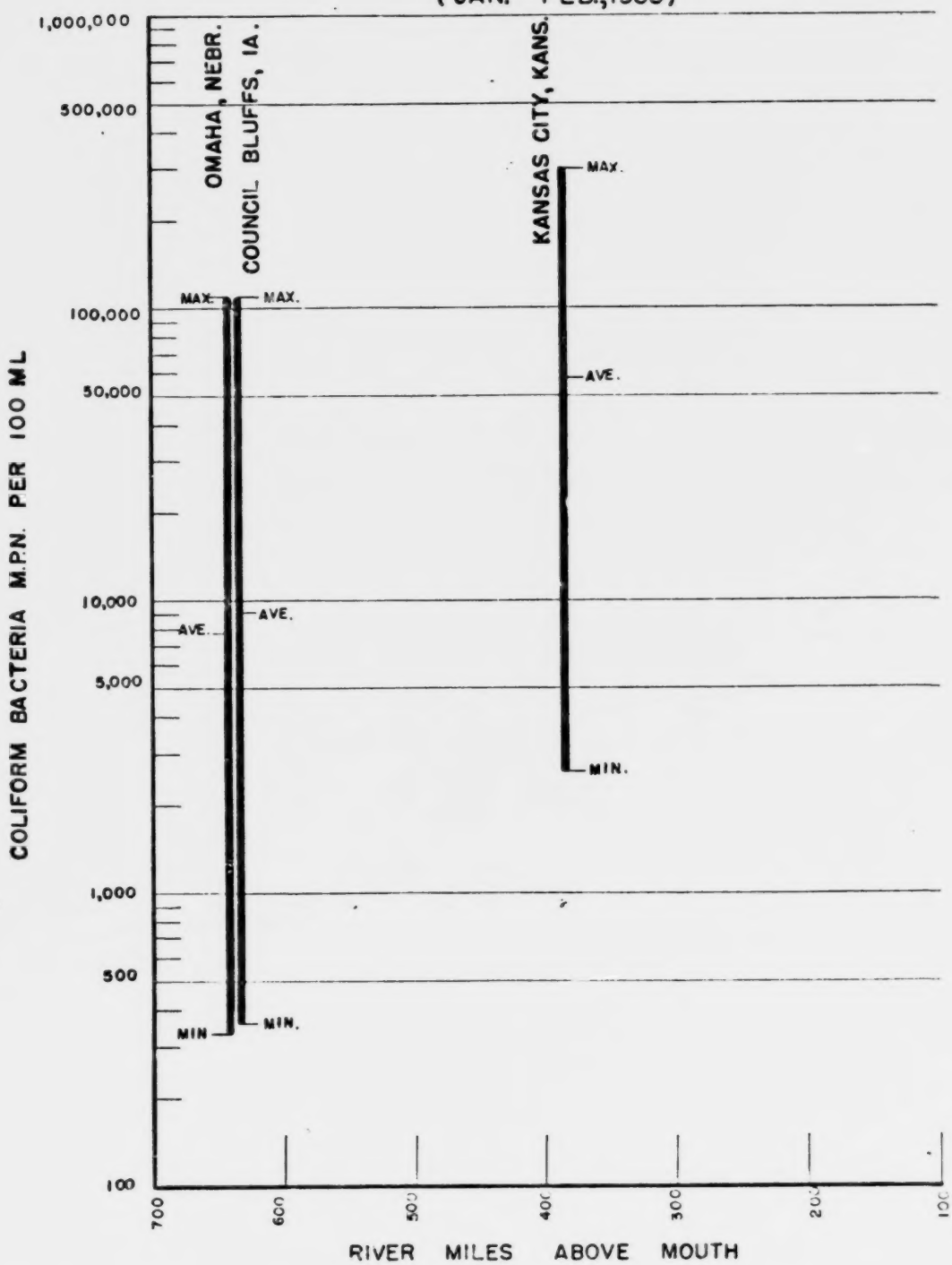


MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES

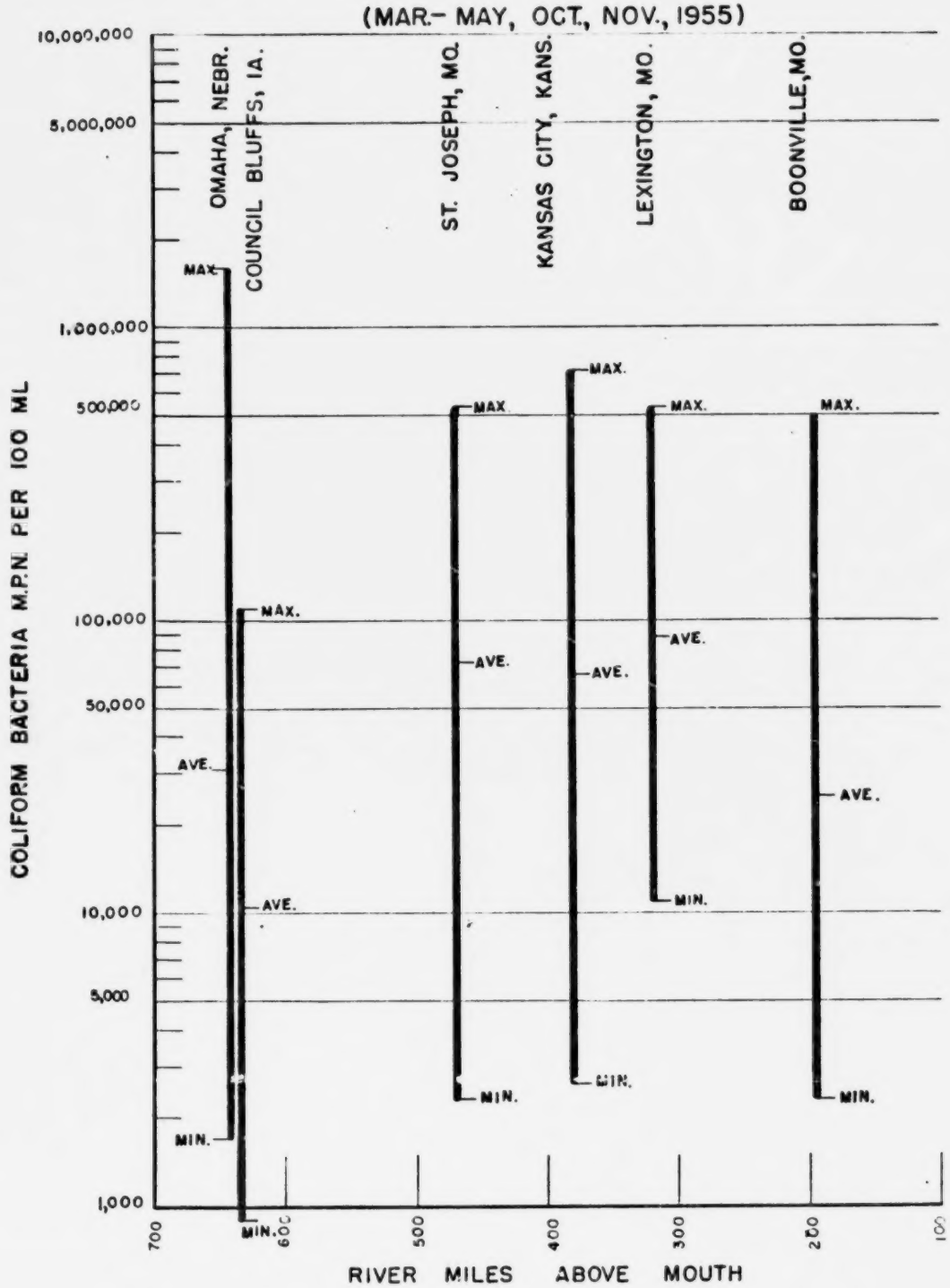
WINTER SEASON

(JAN.—FEB., 1955)



MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES
INTERMEDIATE SEASON
(MAR.- MAY, OCT., NOV., 1955)

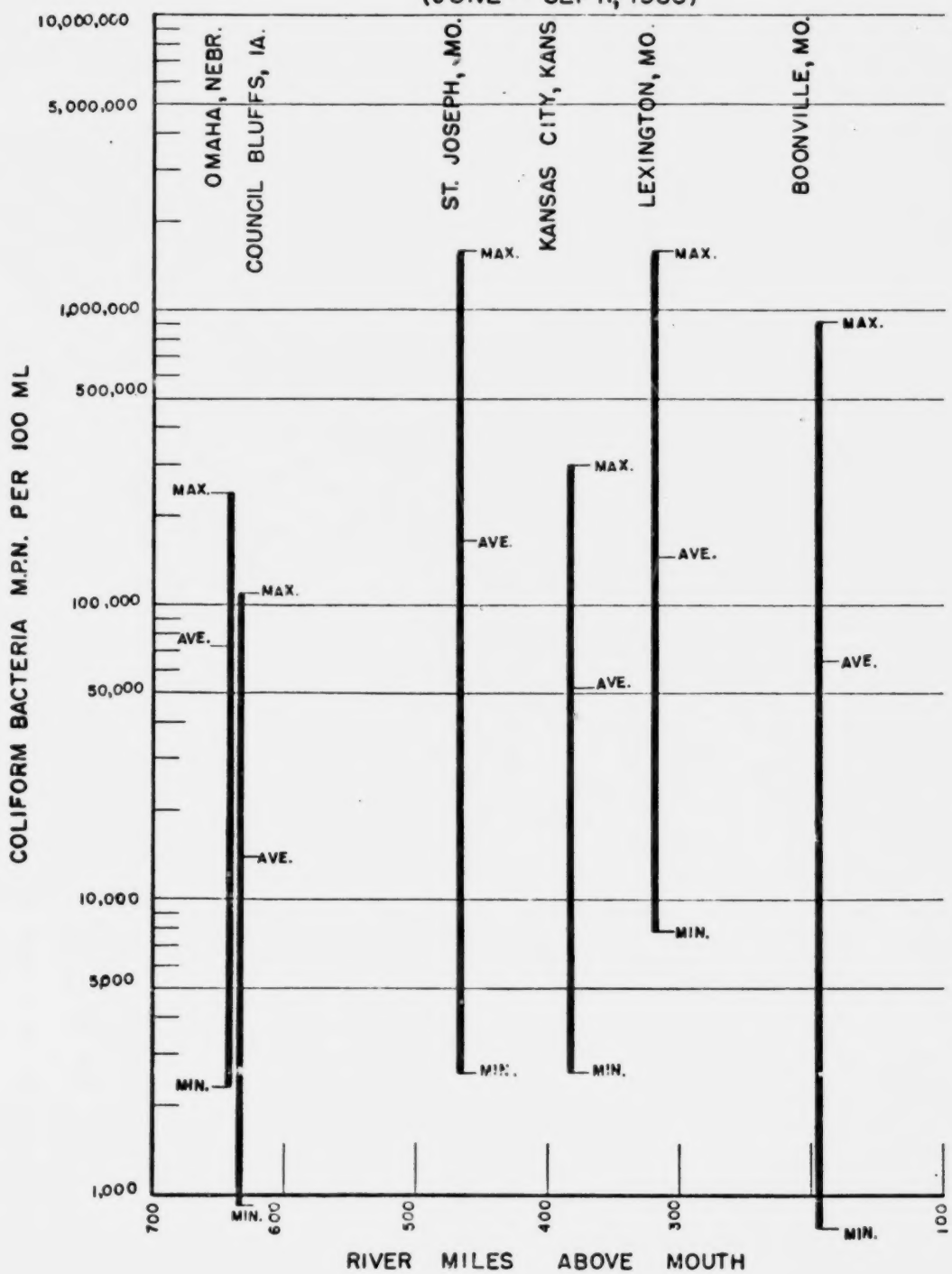


MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES

SUMMER SEASON

(JUNE— SEPT., 1955)

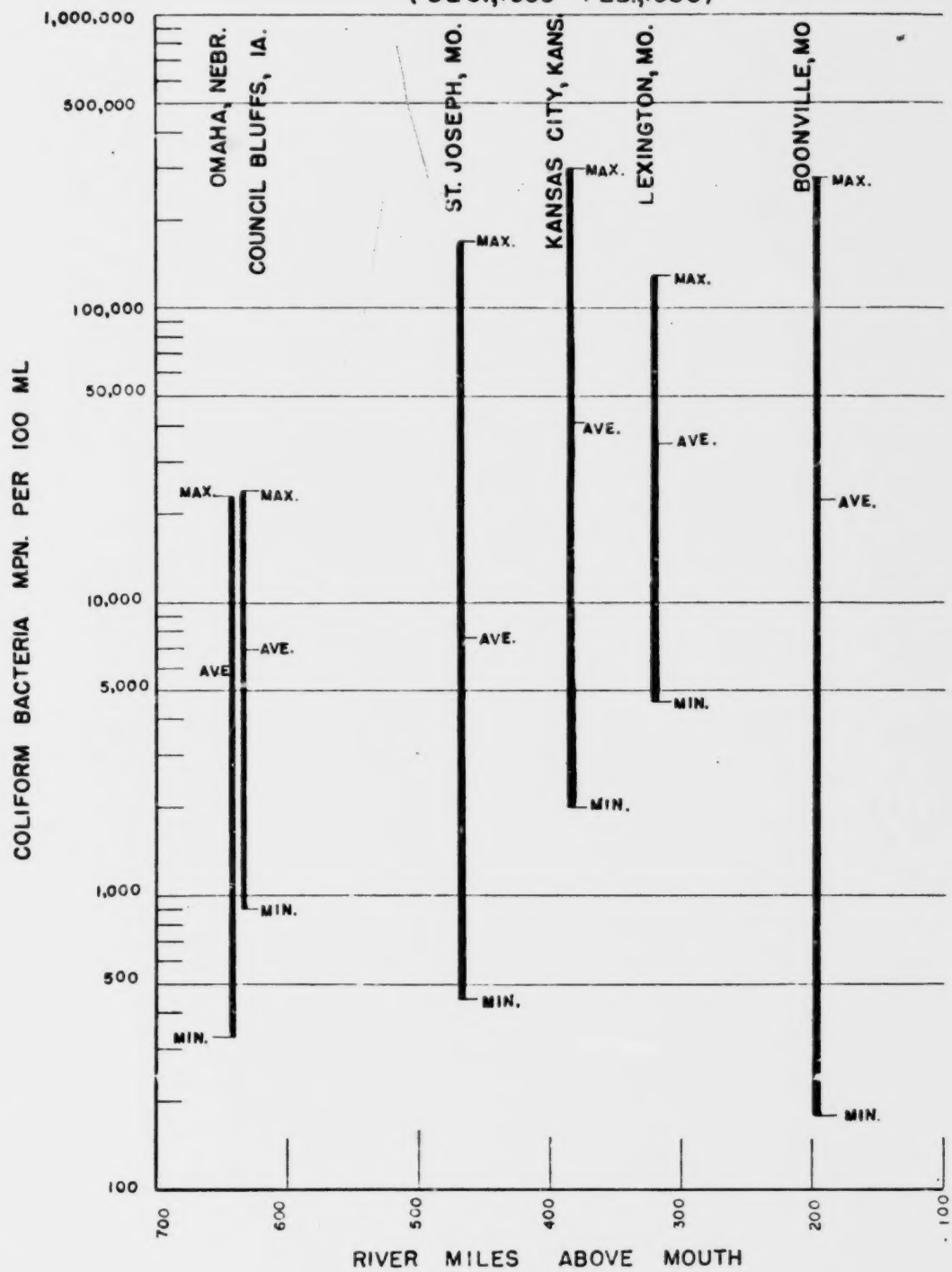


MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES

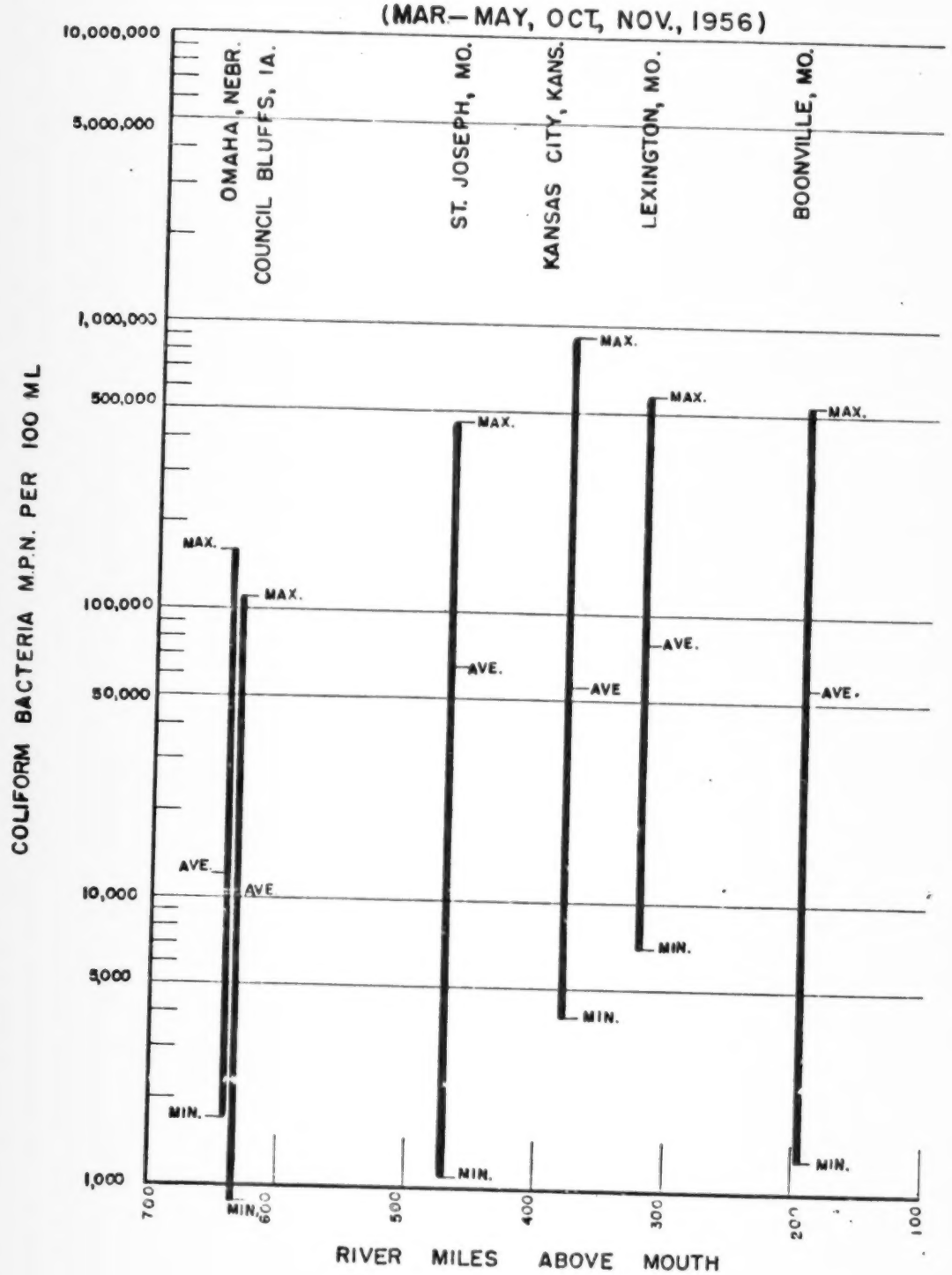
WINTER SEASON

(DEC., 1955 – FEB., 1956)



MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES
INTERMEDIATE SEASON
(MAR—MAY, OCT, NOV., 1956)

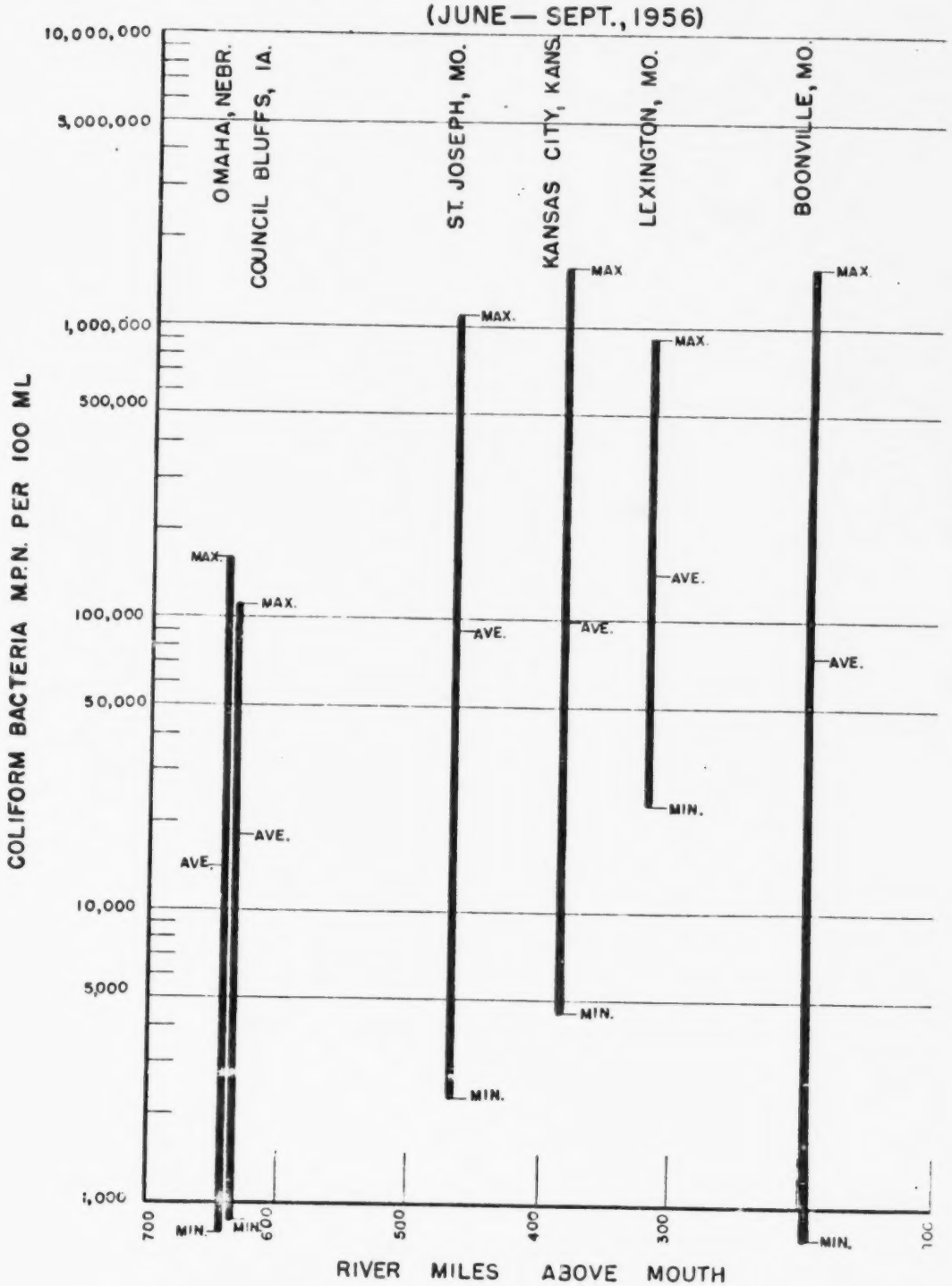


MISSOURI RIVER WATER QUALITY SURVEY

RANGE OF COLIFORM DENSITIES

SUMMER SEASON

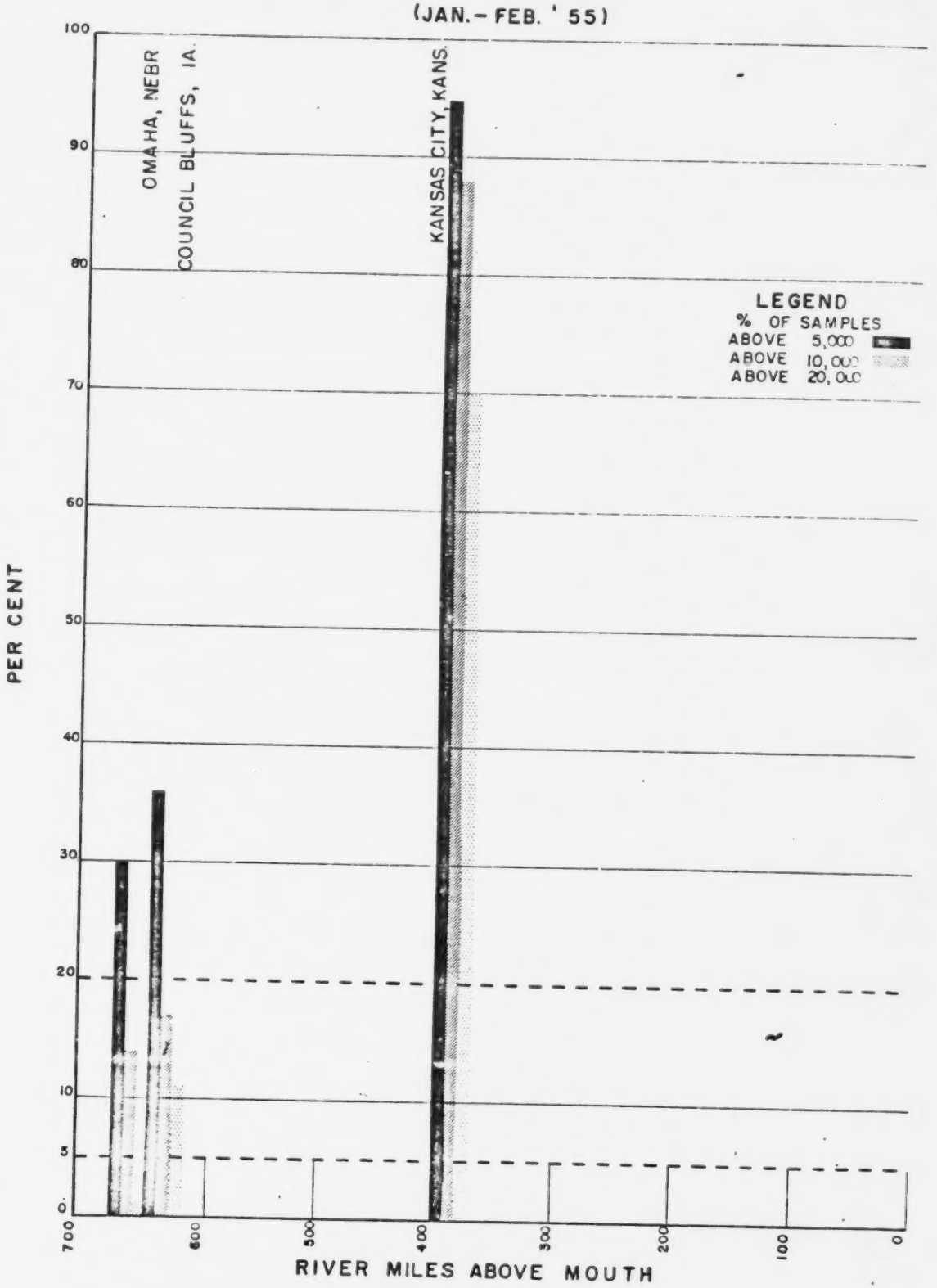
(JUNE — SEPT., 1956)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

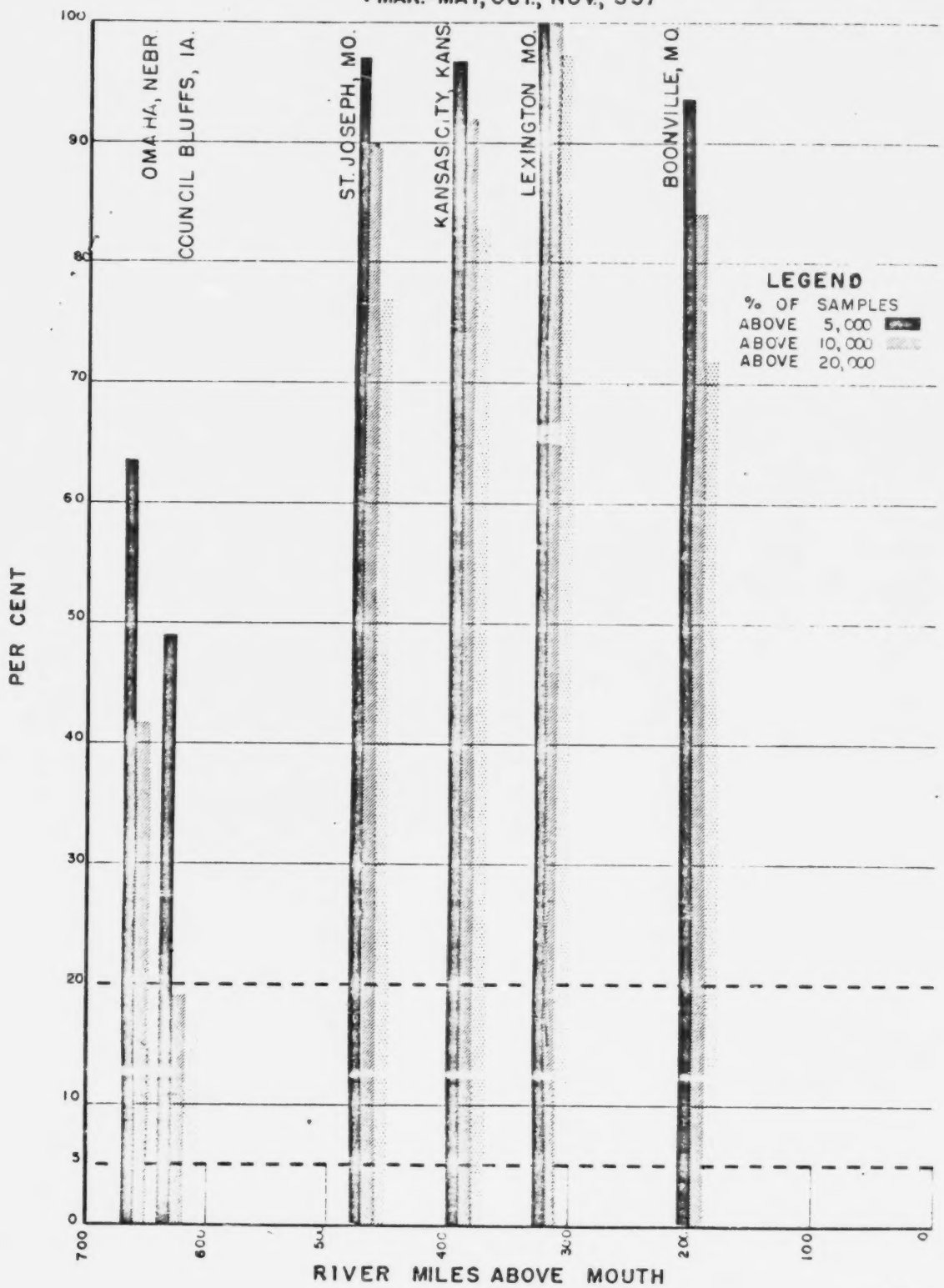
WINTER SEASON
(JAN.– FEB. '55)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

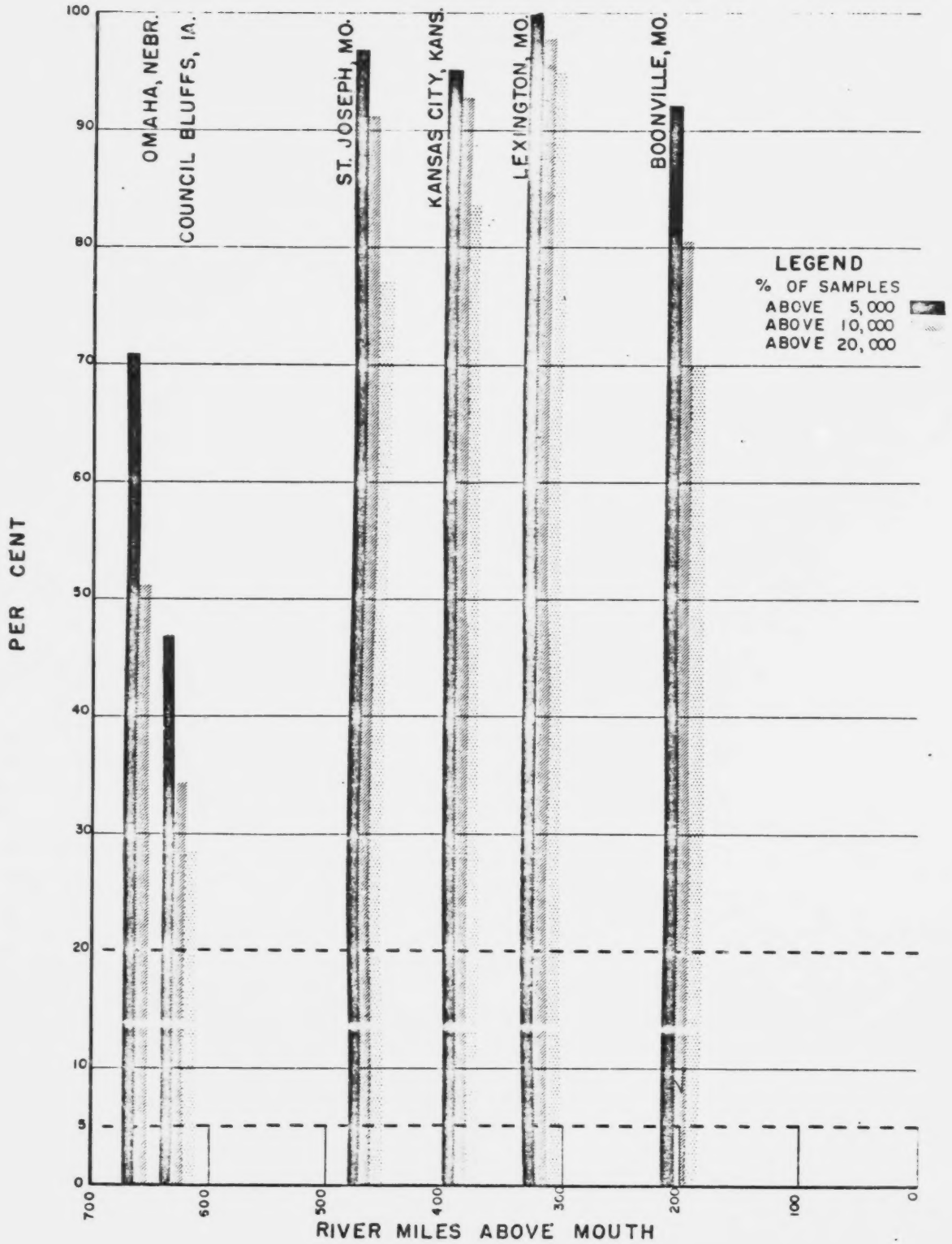
INTERMEDIATE SEASON
(MAR.-MAY, OCT., NOV., '55)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM) EXCEEDING VARIOUS LIMITS

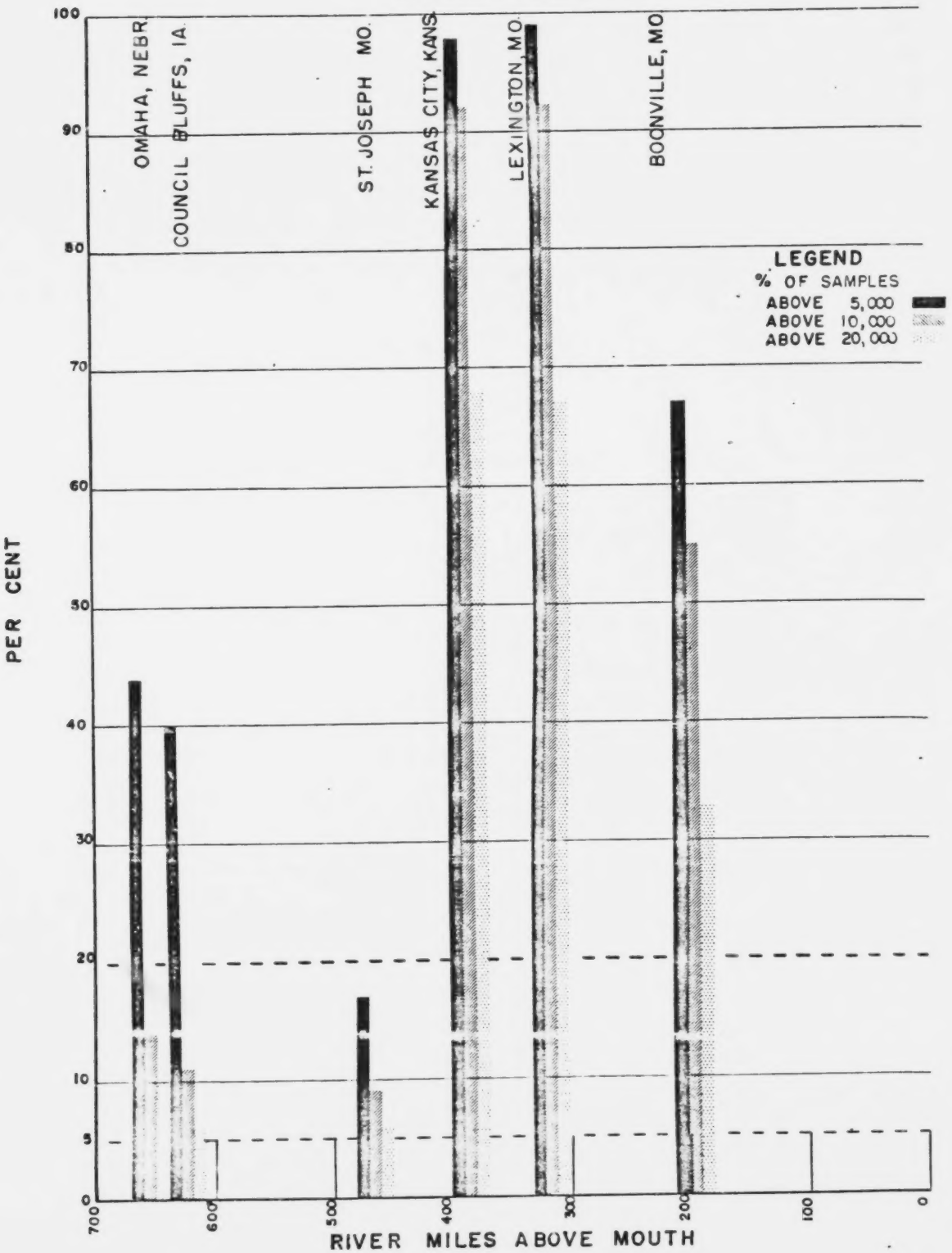
SUMMER SEASON (JUNE-SEPT. '55)



MISSOURI RIVER WATER QUALITY SURVEY.

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

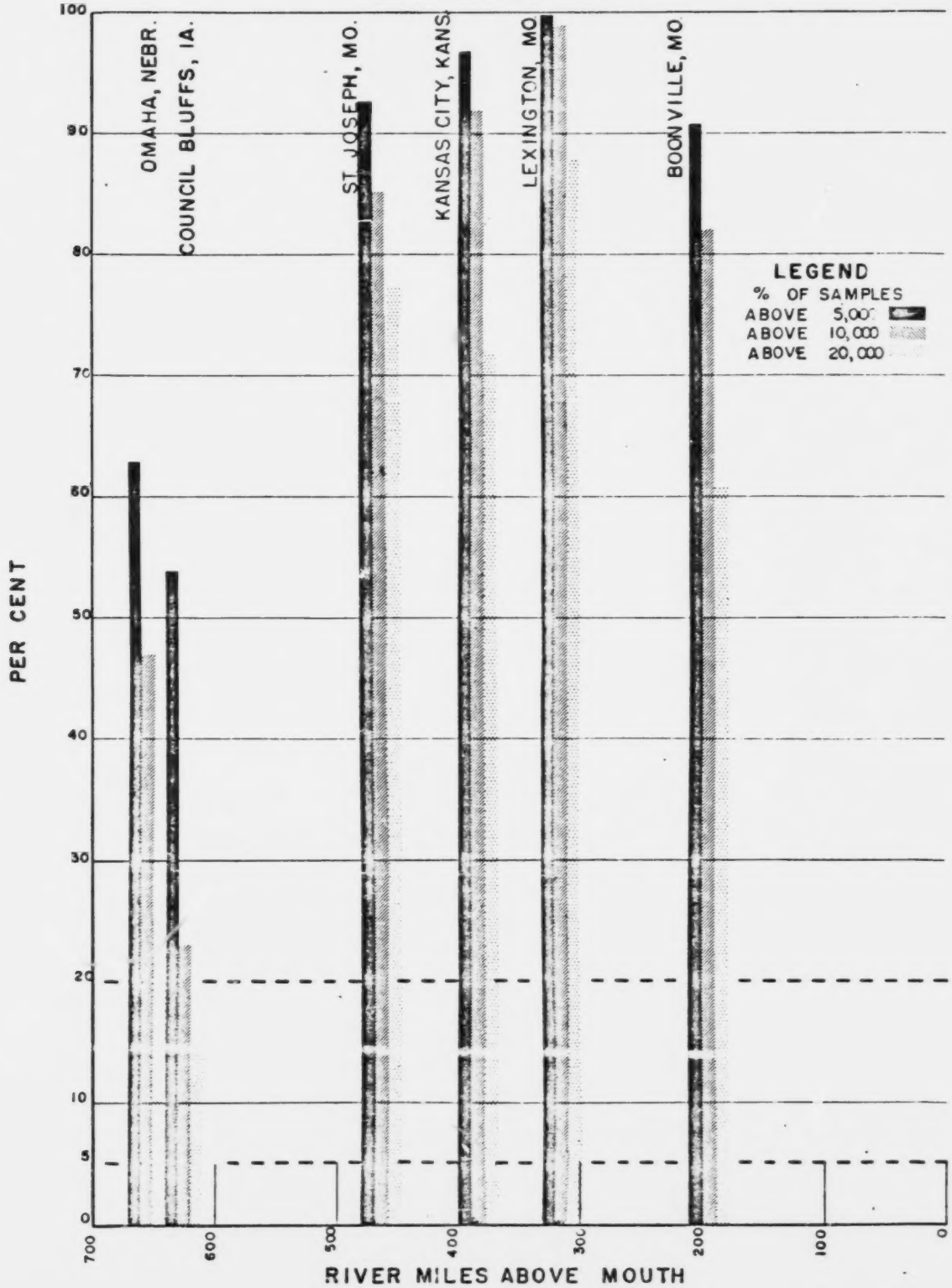
WINTER SEASON
(DEC.'55 - FEB.'56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

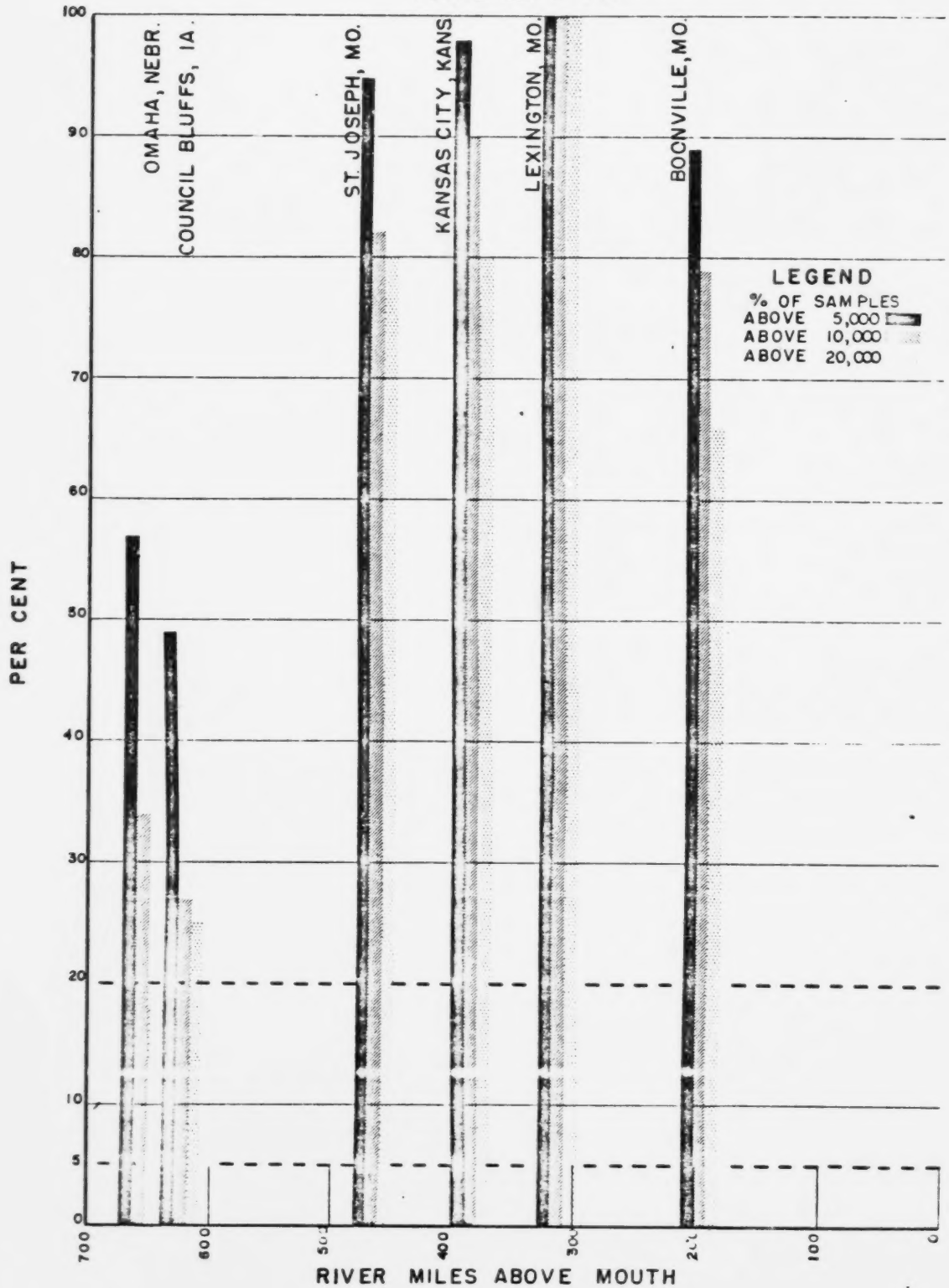
INTERMEDIATE SEASON
(MAR.- MAY, OCT., NOV., '56)



MISSOURI RIVER WATER QUALITY SURVEY

PER CENT OF SAMPLES (COLIFORM)
EXCEEDING VARIOUS LIMITS

SUMMER SEASON
(JUNE-SEPT. '56)

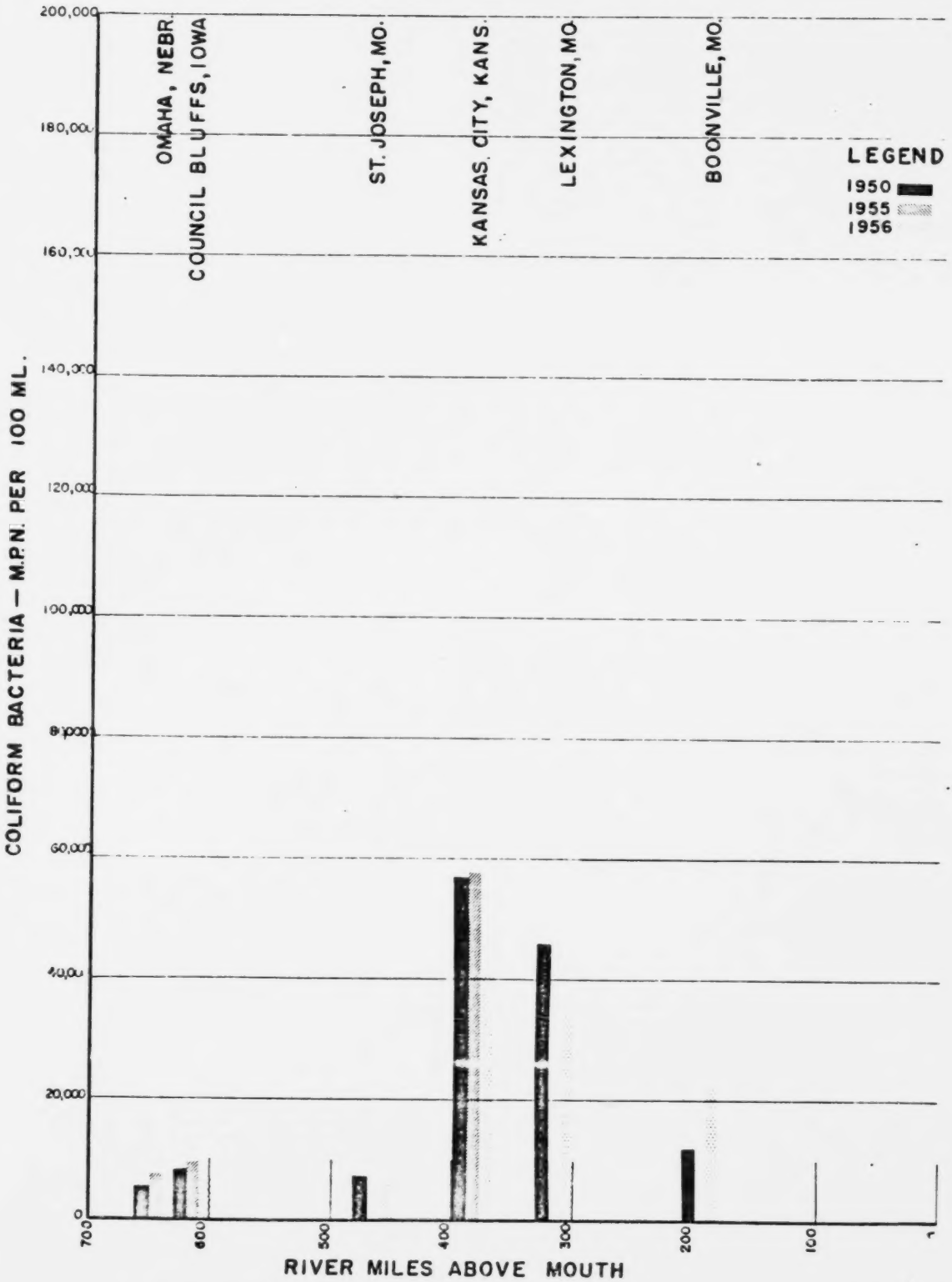


MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE SEASONAL COLIFORM DENSITIES

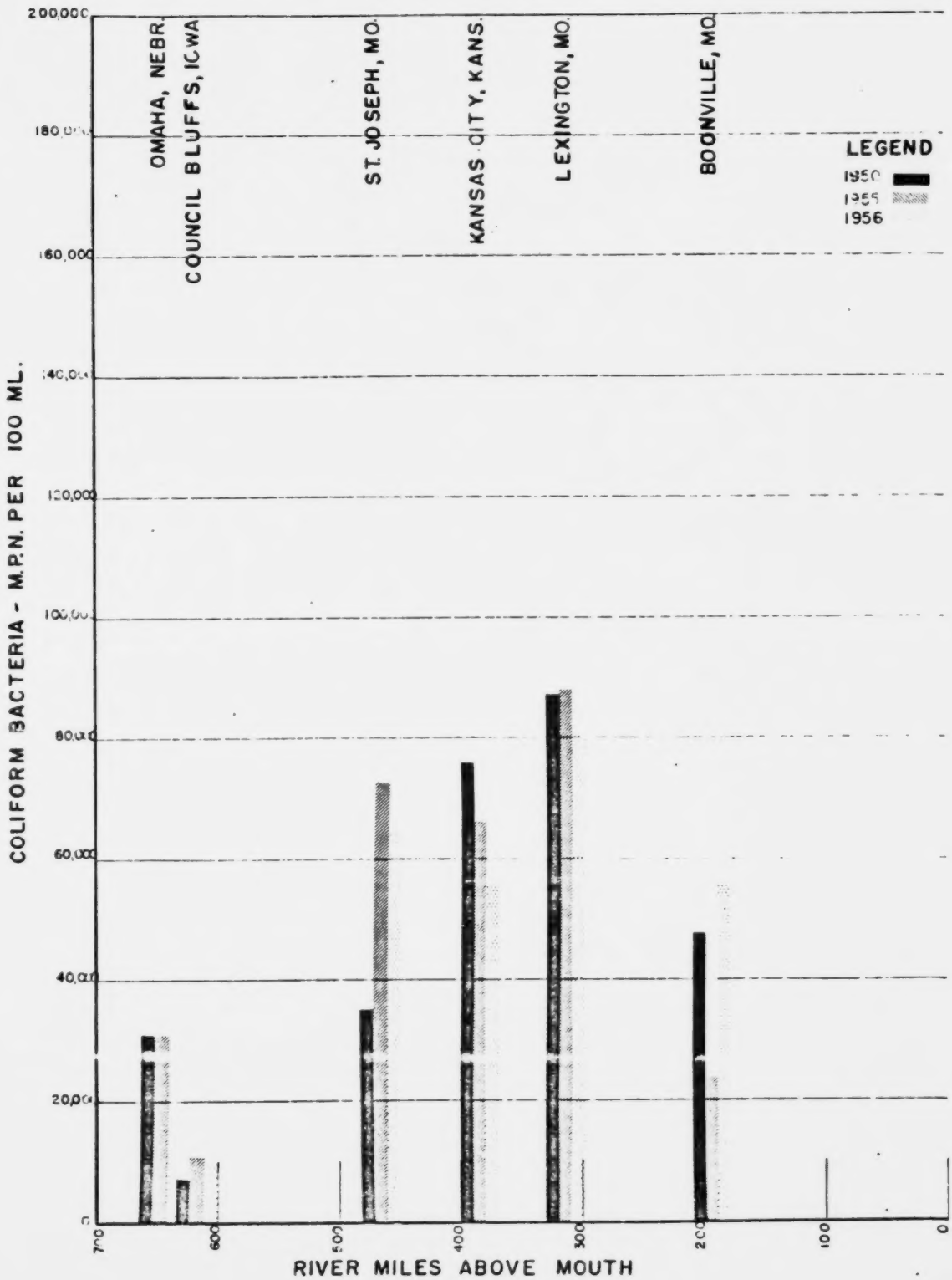
WINTER SEASON

(DEC.- FEB. 1950-55-56)



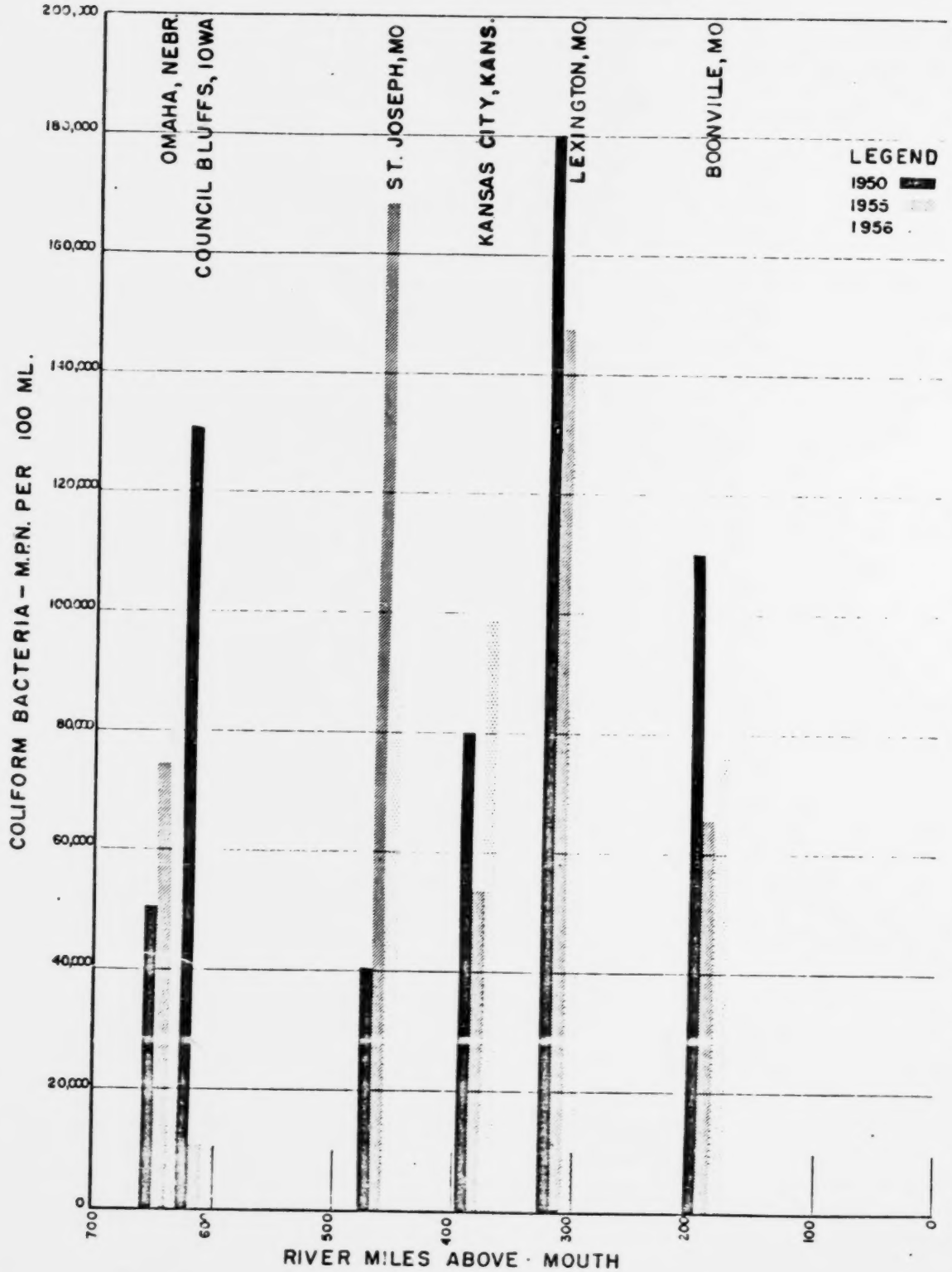
MISSOURI RIVER WATER QUALITY SURVEY

AVERAGE SEASONAL COLIFORM DENSITIES
INTERMEDIATE SEASON
(MAR.- MAY, OCT., NOV., 1950-55-56)



MISSOURI RIVER WATER QUALITY SURVEY

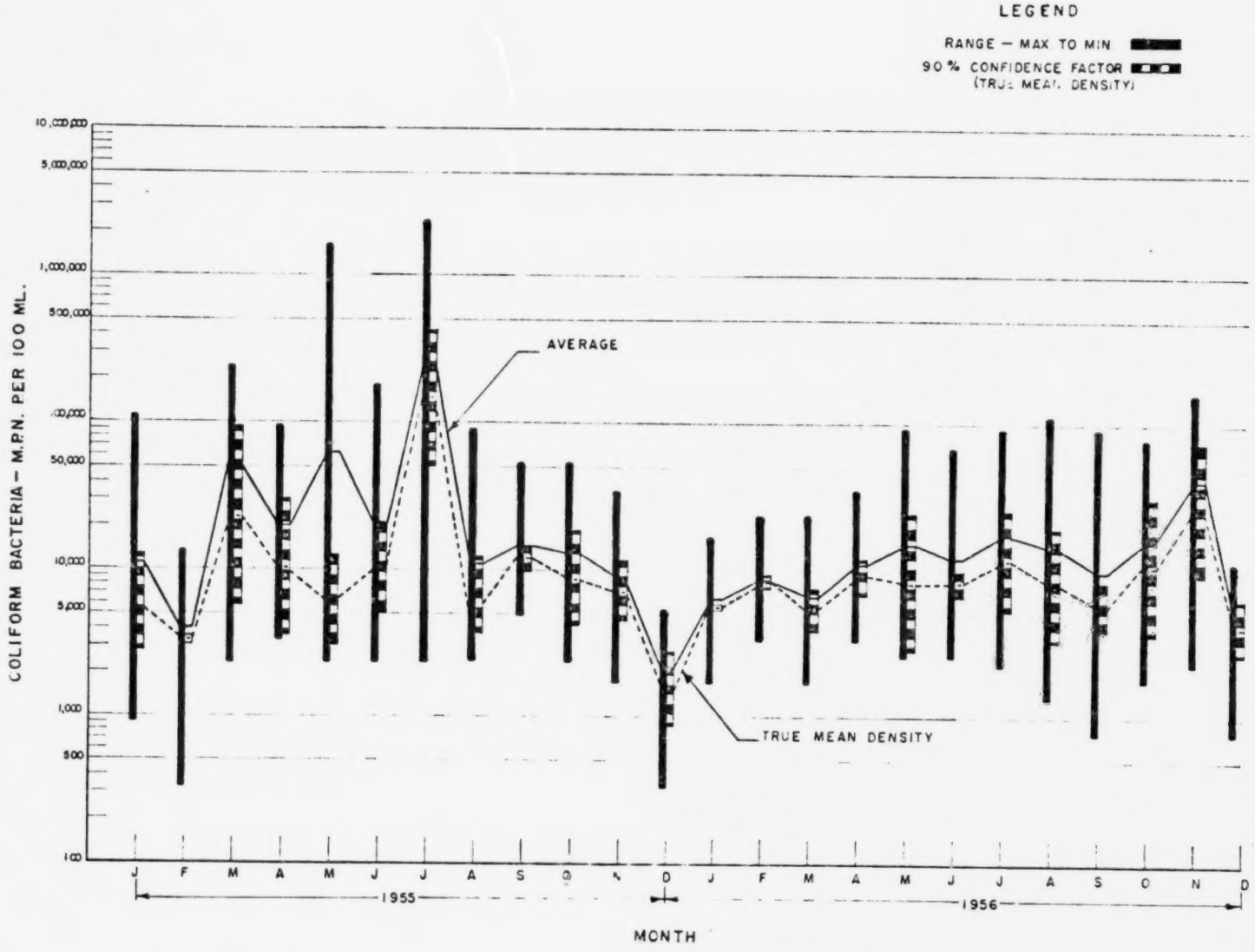
AVERAGE SEASONAL COLIFORM DENSITIES
SUMMER SEASON
(JUNE - SEPT. 1950-55-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

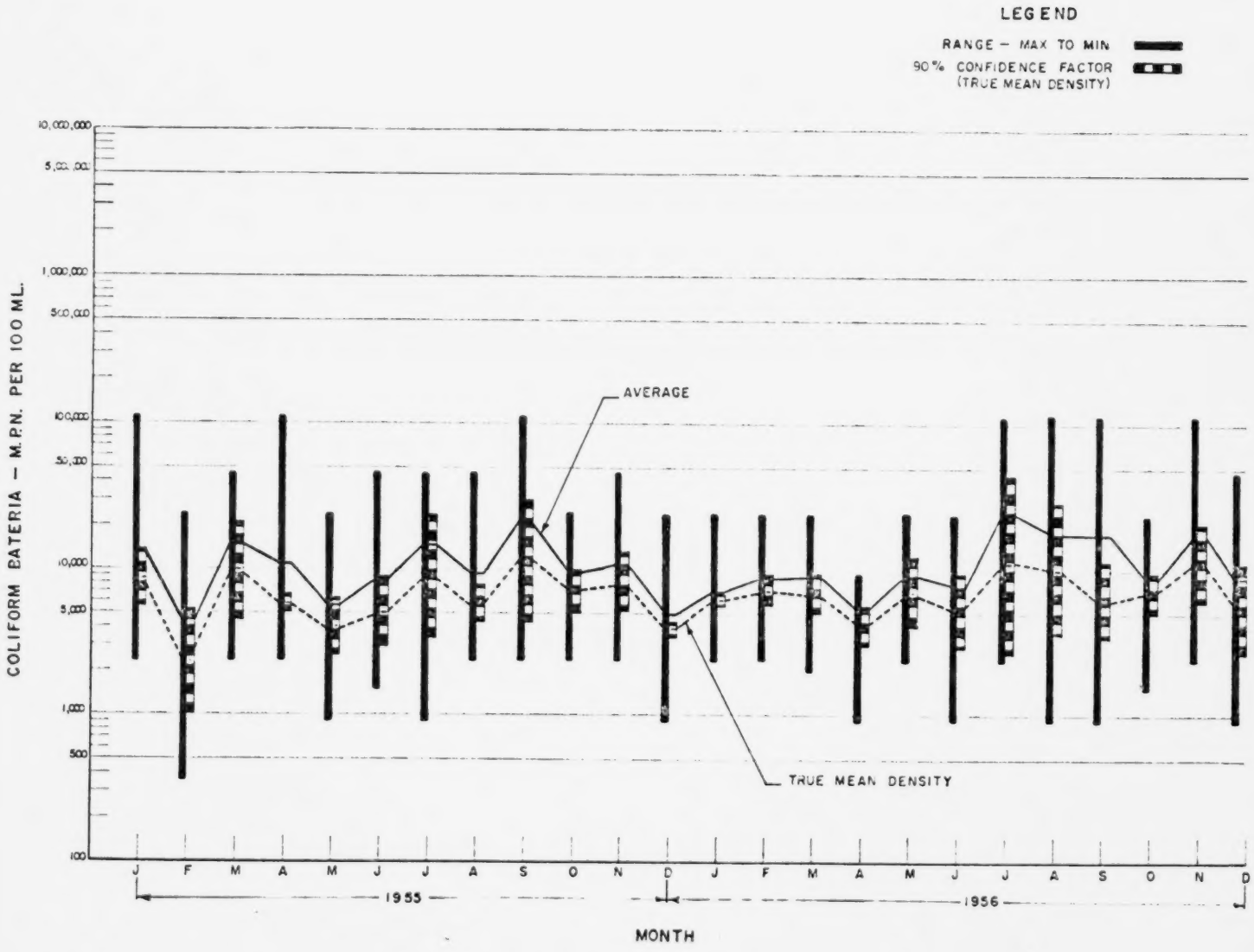
OMAHA, NEBRASKA RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

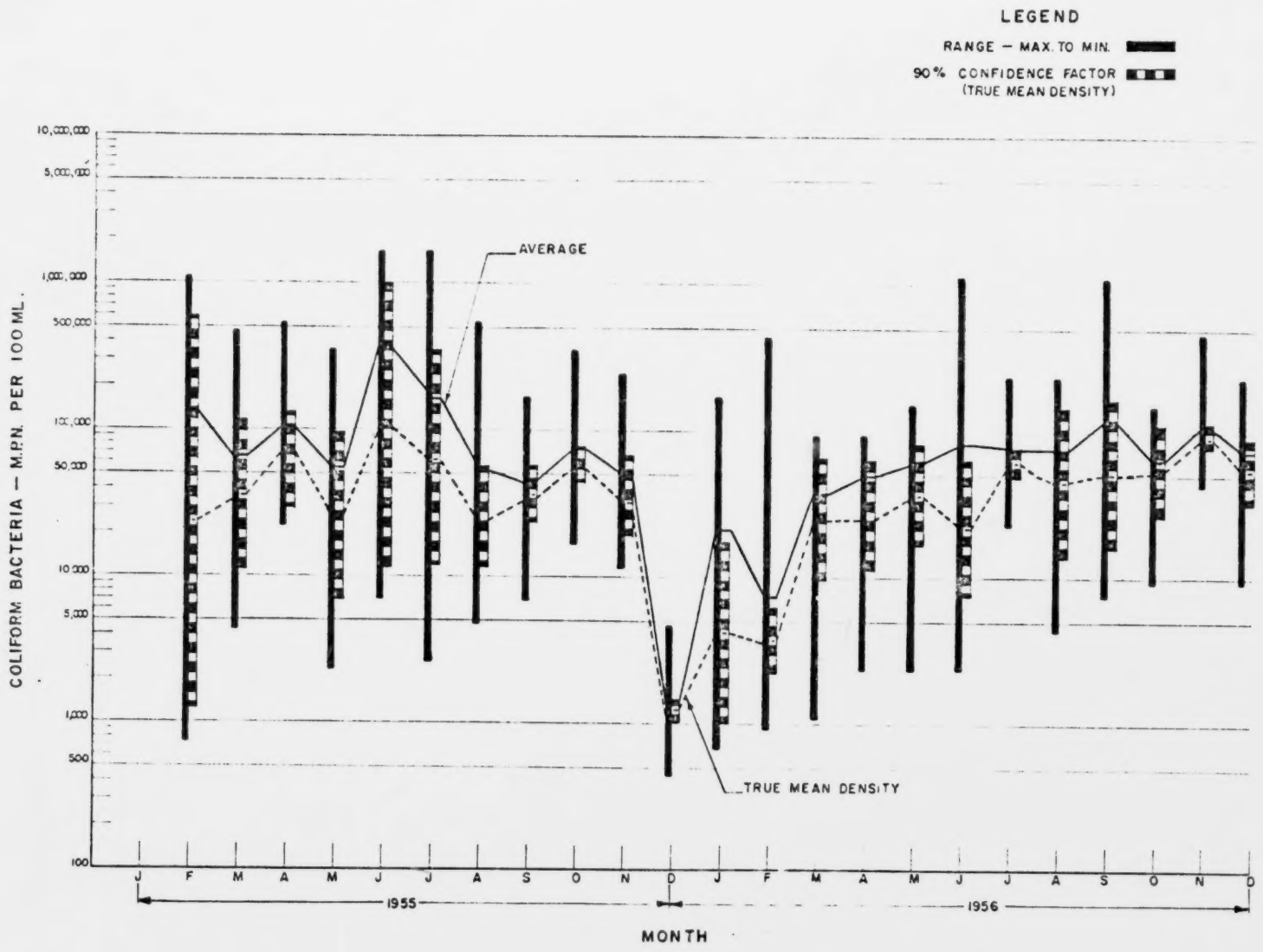
COUNCIL BLUFFS, IOWA RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

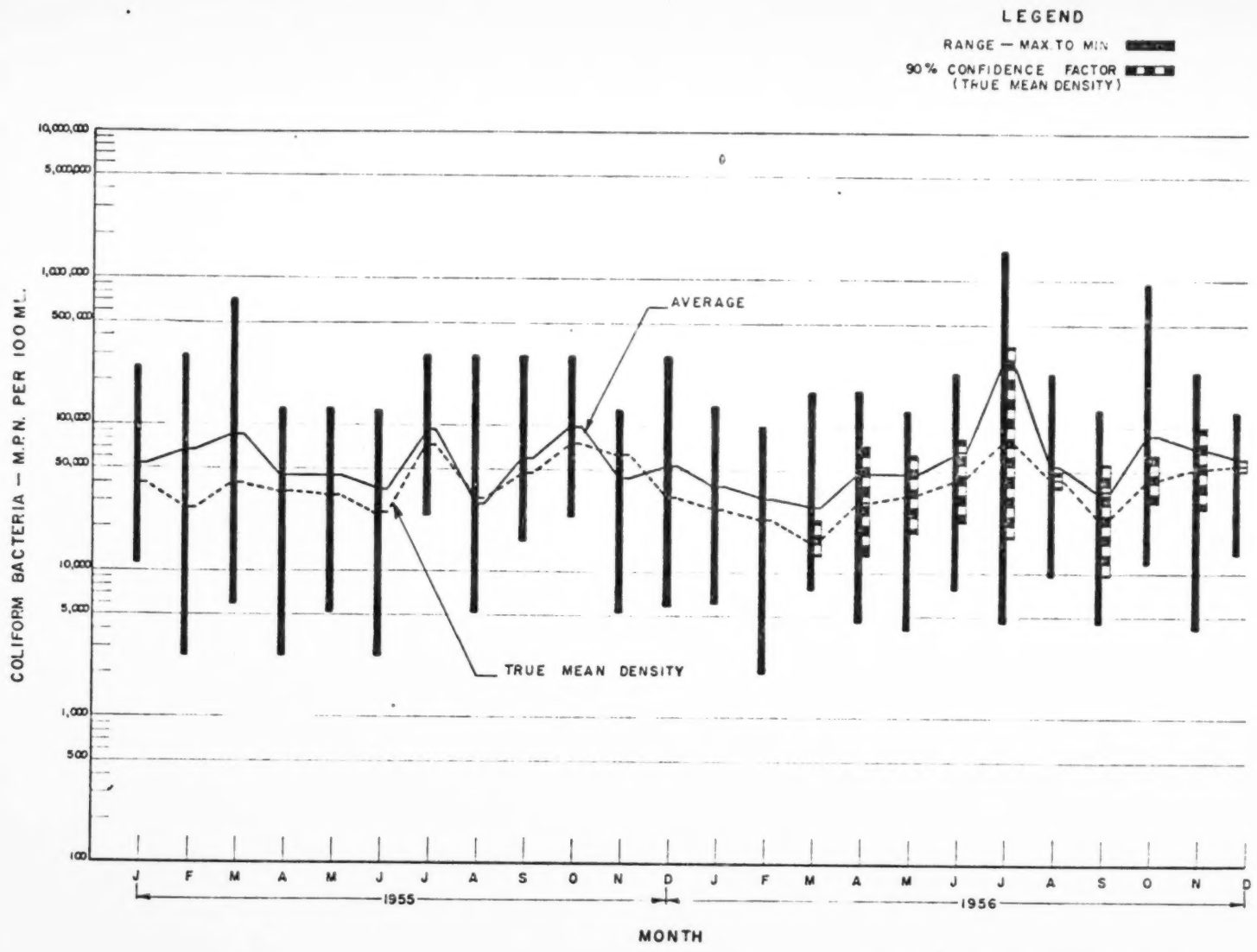
ST. JOSEPH, MISSOURI RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

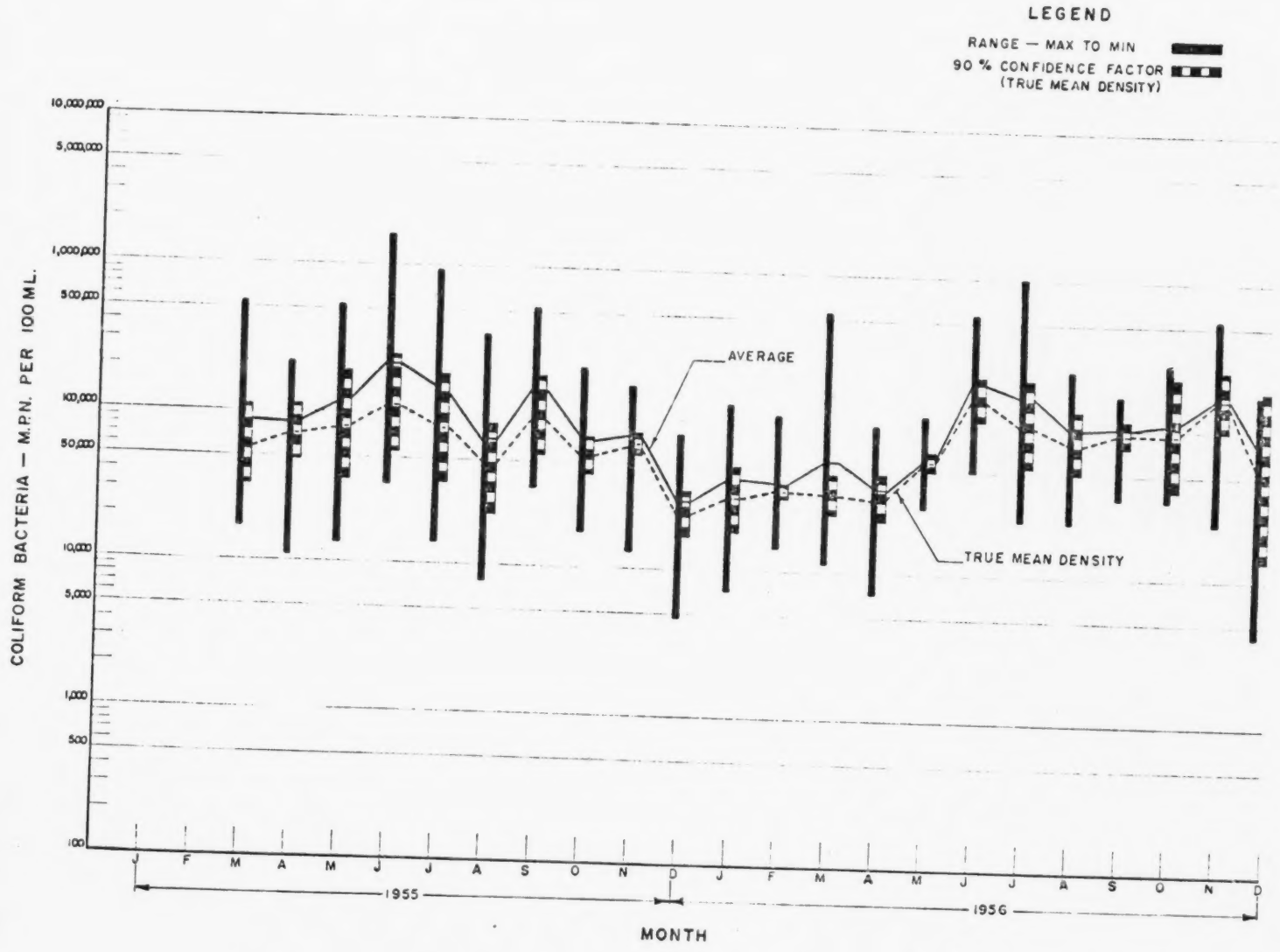
KANSAS CITY, KANSAS RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

LEXINGTON, MISSOURI RAW WATER INTAKE (1955-56)



MISSOURI RIVER WATER QUALITY SURVEY

COLIFORM DENSITIES

BOONVILLE, MISSOURI RAW WATER INTAKE (1955-56)